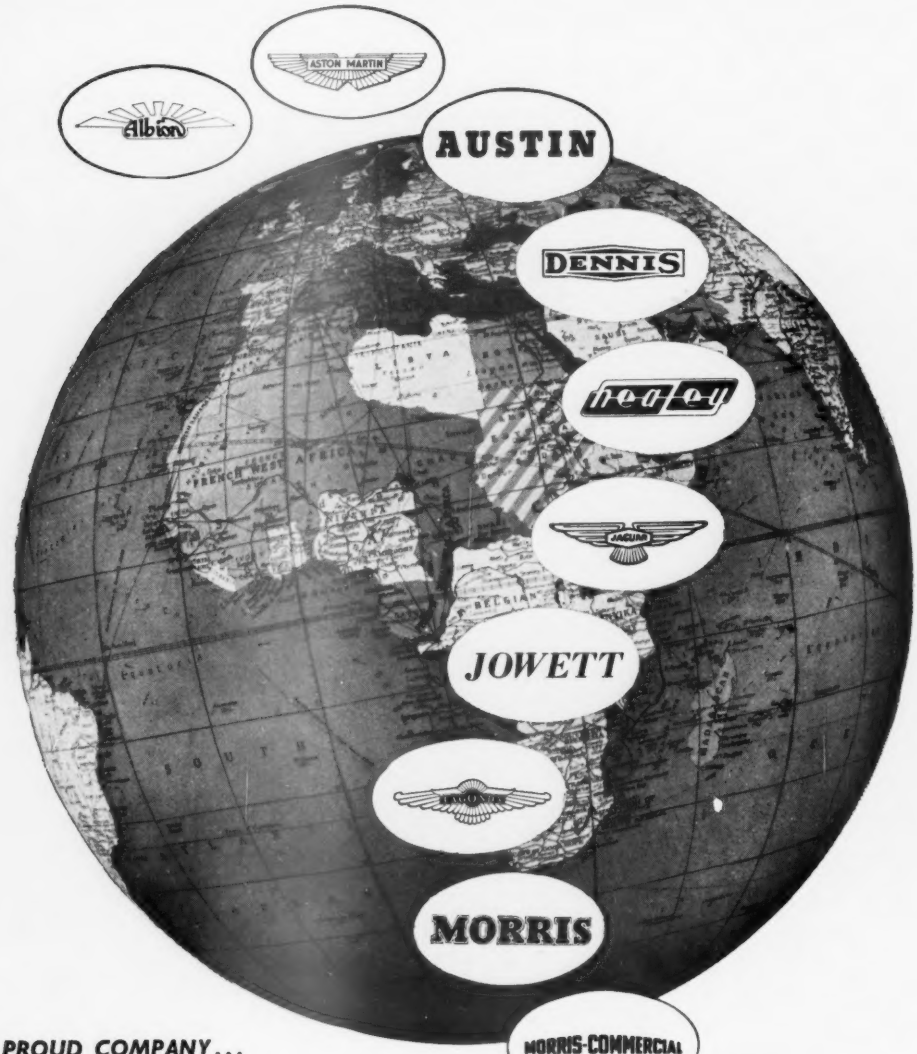
AUTOMOBILE ENGINEER

DESIGN · PRODUCTION · MATERIALS

Vol. 42 No. 557. **SEPTEMBER, 1952** PRICE: 3s. 6d.

HOFFMANN
BALL & ROLLER BEARINGS
FOR EVERY TYPE
OF AUTOMOBILE APPLICATION
FROM UNIVERSAL JOINTS TO GEAR BOXES
THE HOFFMANN MANUFACTURING COMPANY LTD., CHELMSFORD, ESSEX.



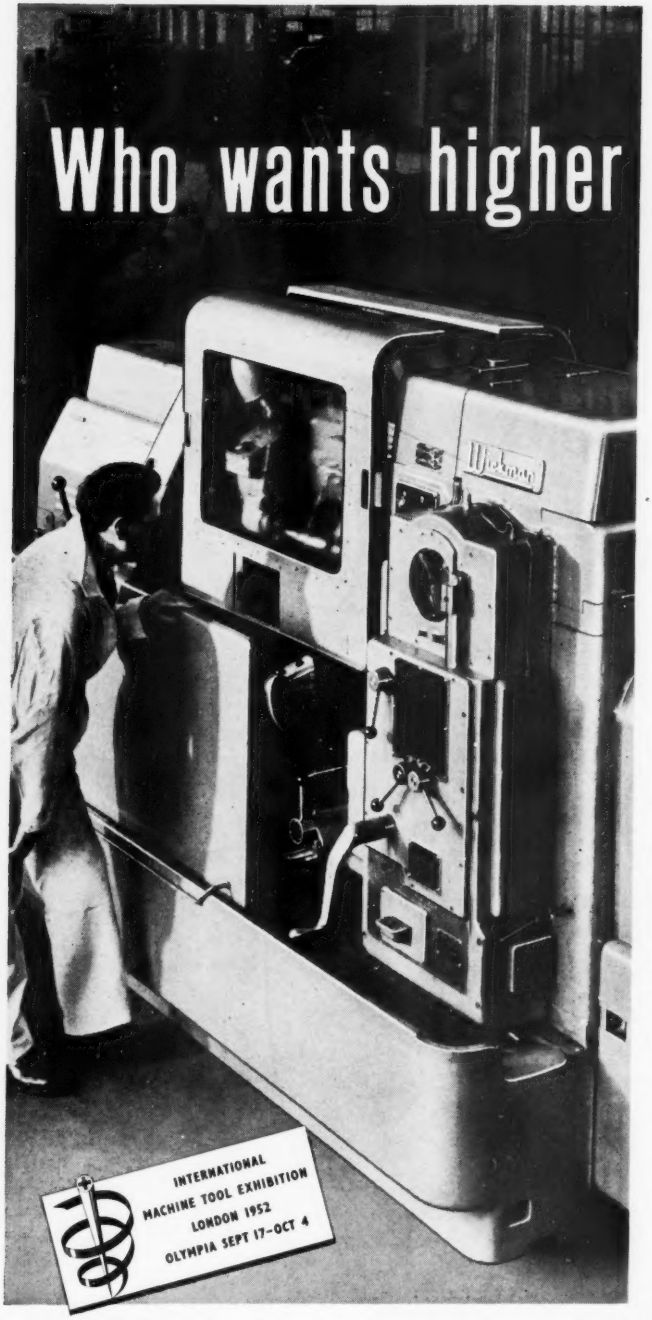
PROUD COMPANY...

The names shown here are famous throughout the motoring world. *Mintex* — having its own share of fame — is proud to be associated with them; they are the names of vehicles produced by manufacturers who fit *Mintex* as original equipment.

For complete reliability you can depend on **MINTEX**

MINTEX BRAKE & CLUTCH LINERS are manufactured by BRITISH BELTING & ASBESTOS LTD., CLECKHEATON, YORKSHIRE and are obtainable from all Mintex Service Depots and stockists.

Who wants higher output?



Well everyone, of course. And many are getting it. The metal-working industries are becoming increasingly automatic-minded . . . one reason why so many producers of turned parts are thinking in terms of Wickman Automatics—the Coventry-built multi-spindle machines with the exclusive no-cam changing feature.

More and more of these fast producers are helping to raise output in Britain's major industries, supported by a comprehensive tooling and engineering service.

A full range of these machines will be demonstrated at the International Machine Tool Exhibition, Olympia.

Wickman 6" Five Spindle Chucking Automatic.

WICKMAN *of* **COVENTRY**

LONDON · BRISTOL · BIRMINGHAM · MANCHESTER
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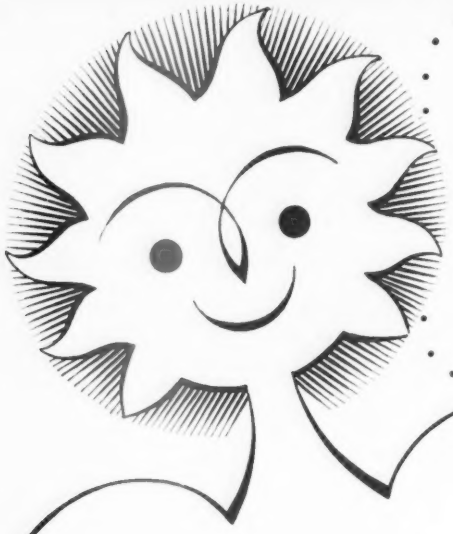
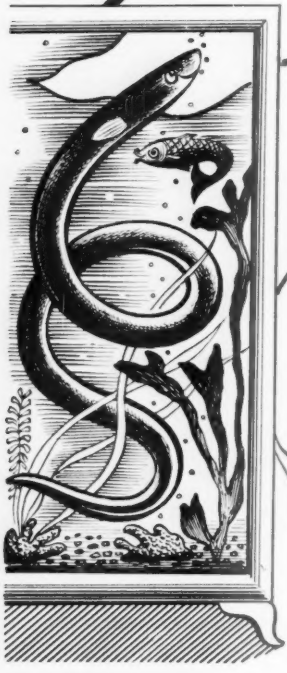
Wickman

254 WM.



I, too, am unusually flexible!

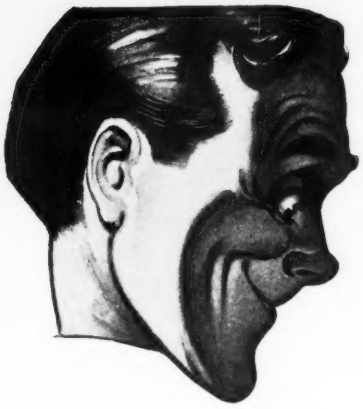
Gas has claims to be the most generally versatile and flexible fuel known to man. There is almost no limit to the variety of gas-fired equipment and appliances either available or designable. For jobs big or little, straightforward or intricate, flow-production or 'one-off', gas nearly always turns out to be the simplest to install, the easiest to maintain and the most economical to operate. There's no handier man at a heating job than Mr. Therm.



Mr. THERM IN GENERAL ENGINEERING

Among the great variety of uses of gas are: general heat treatment, flame hardening, annealing, tempering, case hardening, normalising, preheating, metal melting, core drying, forging, brazing, soldering, oxy-town gas cutting, steam-raising, water and space heating.

Mr. Therm burns to serve you · THE GAS COUNCIL · 1 GROSVENOR PLACE · LONDON · SW1



what's the drill?

same again!

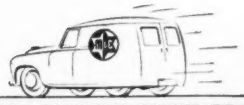
"And I wouldn't say 'no' to a drink
for every twist drill Monks & Crane keep in stock."

"Wouldn't do, old boy.
You'd never survive to see them off."

"Well—make it for every item then."

"Still formidable. But I'll tell you what . . .
I'll stand you a drink every
time Monks & Crane let you down."

"You're on a good thing—
they haven't disappointed me in years!"



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THE TWIST DRILL SPECIALISTS

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SM/MC.802b

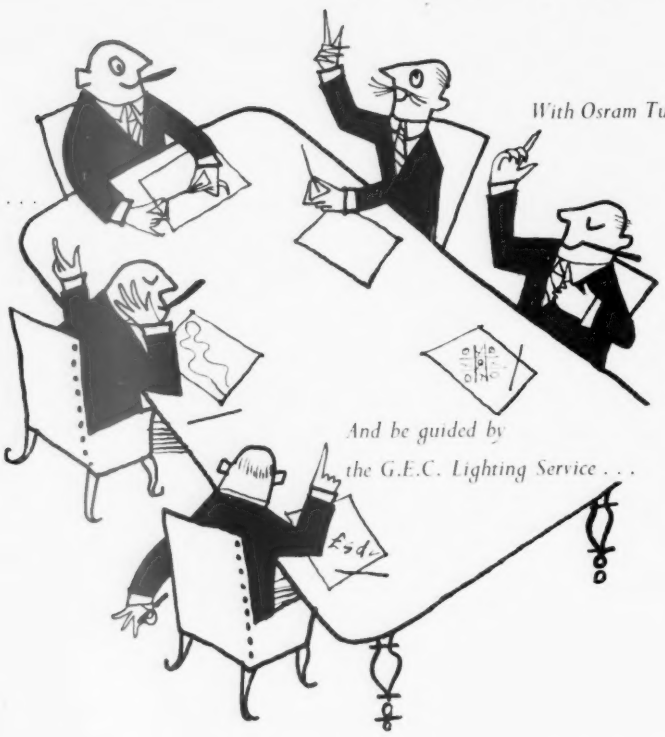
Decided?

Yes, install fluorescent lighting . . .

With Osram Tubes . . .

In G.E.C. fittings . . .

And be guided by the G.E.C. Lighting Service . . .



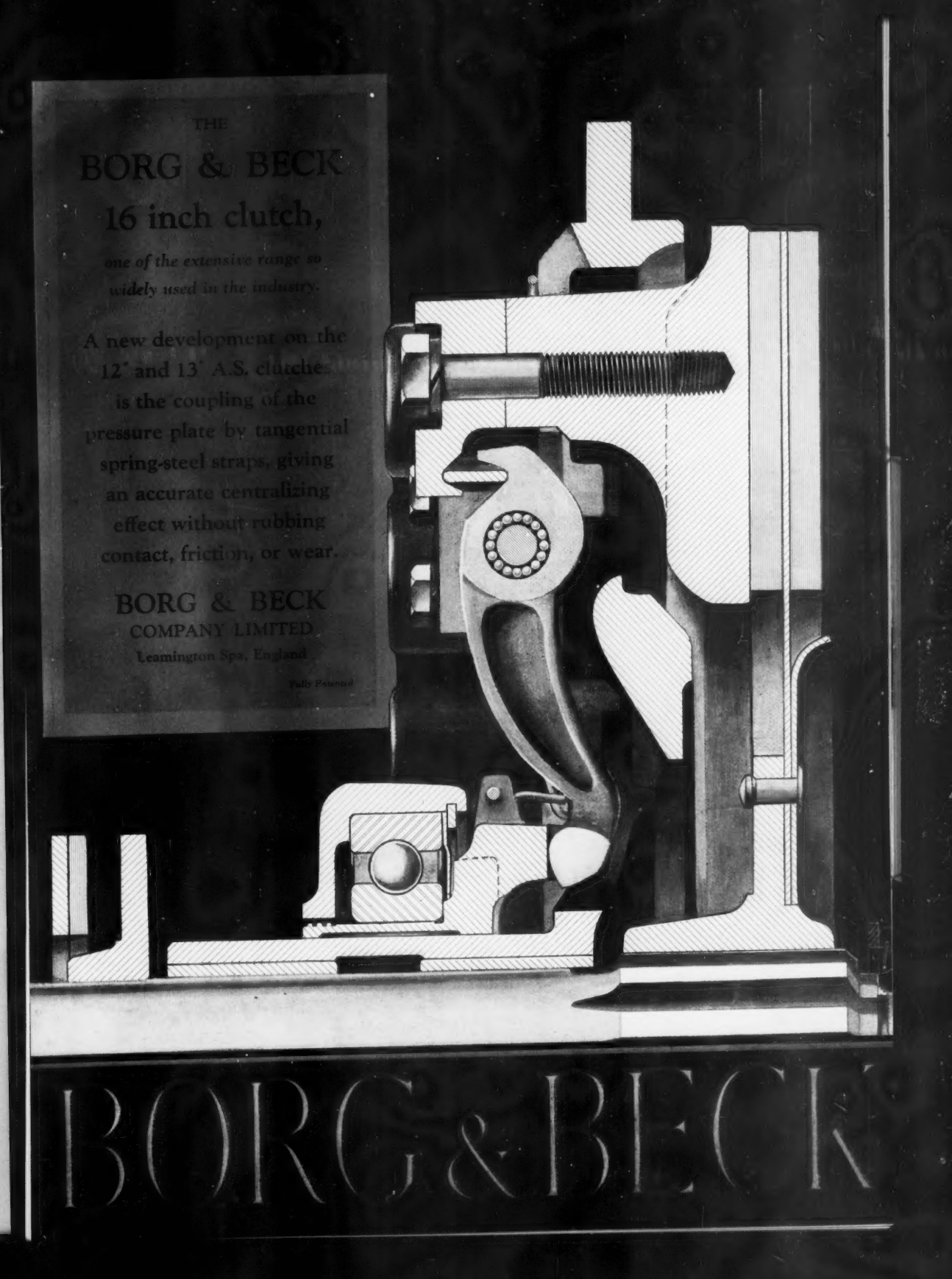
Fluorescent lighting?

Of all forms of lighting, fluorescent is by far the most economical. Without adding a penny to your lighting bill it would increase illumination by over 50%—or, if you are satisfied with the power of your present lighting, it would save over half your annual expenditure on current! Here is something to discuss with the G.E.C., the pioneers of fluorescent lighting. The G.E.C. Advisory Lighting Service will gladly help in planning the right installation. To decide on fluorescent should not be difficult—but see the G.E.C. first.

Osram

tubes in G.E.C. *fittings*

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2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one of the extensive range so widely used in the industry.
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COMPANY LIMITED
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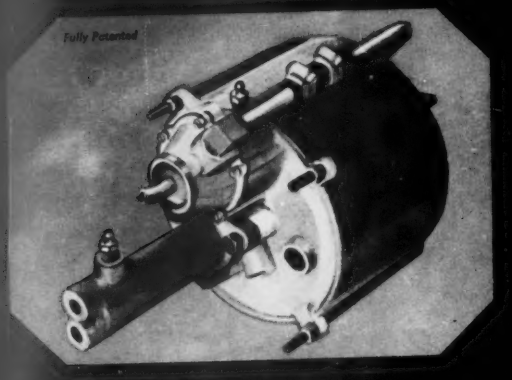
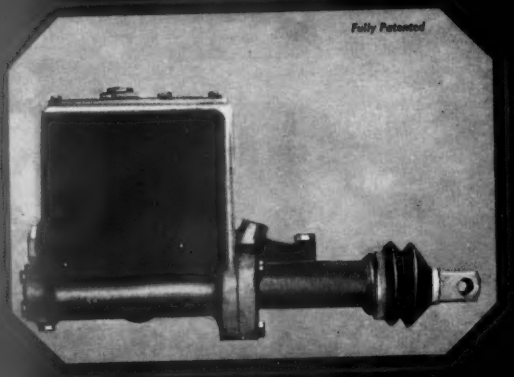


LOCKHEED RANGE



COMMERCIAL

TYPE	ACTUATION	SERVO	BRAKES
Light Commercial Vehicles	Lockheed hydraulic		Lockheed two-leading shoe Rear: Lockheed leading and trailing shoes
Medium Commercial Vehicles	Lockheed hydraulic		Lockheed two-leading shoe front and rear
Up to 8½ tons gross	Lockheed hydraulic	Lockheed 'Hydrovac' actuated from induction system or from vacuum pump	Lockheed two-leading shoe front and rear
Up to 11½ tons gross (4 wheels) Up to 14½ tons gross (6 wheels)	Lockheed hydraulic Lockheed hydraulic	Lockheed 'Hydrovac' or Lockheed hydraulic servo	Lockheed two-leading shoe front and rear
Up to 22 tons gross (6 and 8 wheels)	Lockheed hydraulic	Lockheed hydraulic servo	Manufacturer's own

PUBLIC SERVICE

	Lockheed hydraulic	Lockheed hydraulic servo. Also operates ancillaries	Manufacturer's own

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Self-adjusting
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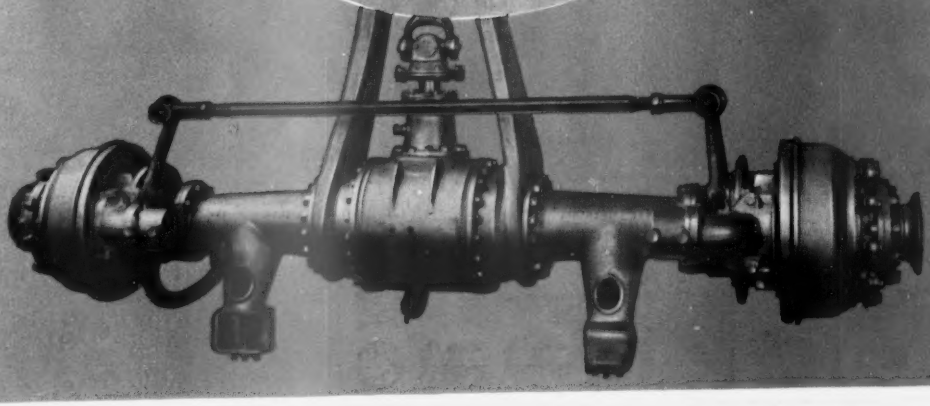

Think of a diesel's life

Mr. J. Mulley and his chief mechanic showing freshly drawn piston to Mr. A. W. Braybrooke of A. F. Braybrooke and Sons of Swaffham and Mendlesham —another large operator.

Photo. Lambert, Bury St. Edmonds

then double it!

"We should normally expect to draw pistons around 50,000 miles—but we found that with Shell Rotella Oils in use we go upwards of 100,000 miles," say Mulley's Motorways, of Ixworth and Bury St. Edmunds, Suffolk, giving these examples:—

6-cylinder Leyland P.S.I.—104,000 miles, pistons drawn—cylinder good—only new rings fitted.

6-cylinder Leyland P.S.I.—96,000 miles, general decarbonise—no renewals.

7.7 A.E.C.—100,000 miles, new rings only.

Leyland Comet.—Over 60,000 miles to date untouched.

Leyland P.S.I.—Over 40,000 miles to date untouched.

Mulleys make a practice of draining regularly at 2,000-mile intervals " and naturally," they add, " with such excellent results we have all our diesels running exclusively on Shell Rotella Oil 20 and 30."

And now—Shell's constant research for better lubricants has produced a new Shell Rotella Oil, embodying all the superior qualities of the former oil but with even greater anti-ring stick and anti-wear properties.

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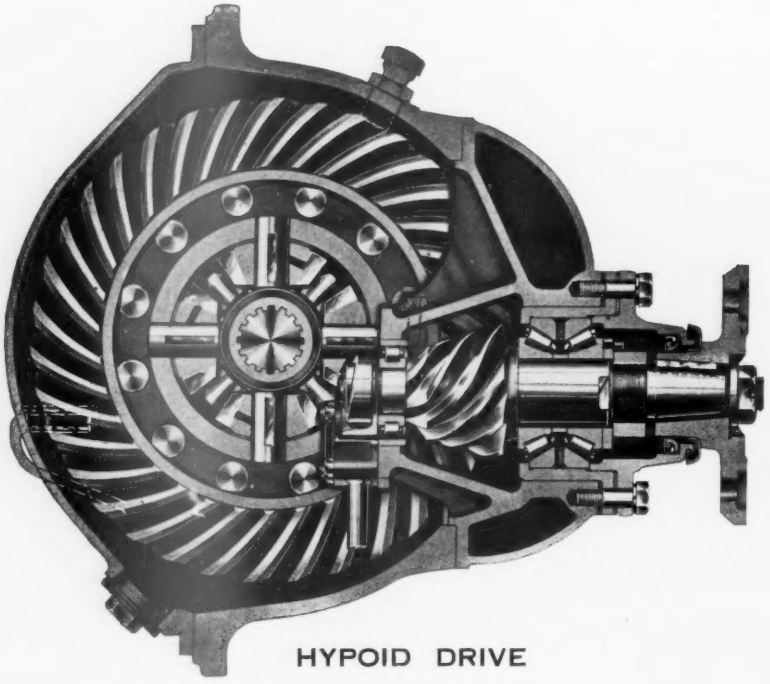

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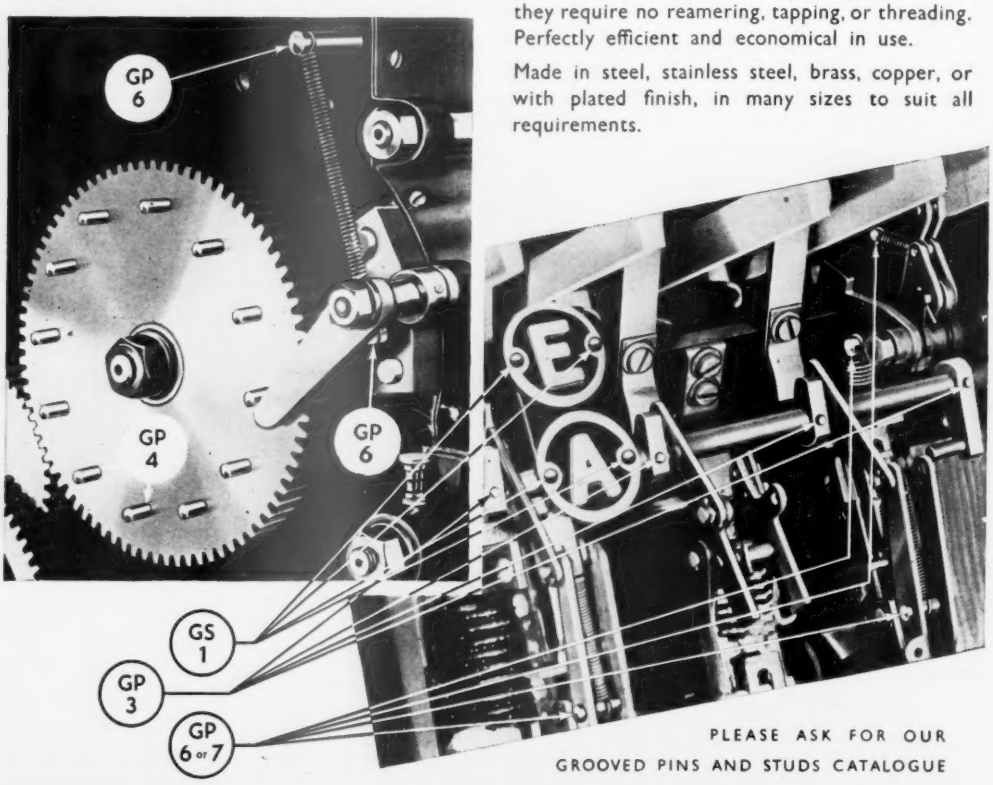

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THE TRUCK WITH A HUNDRED USES

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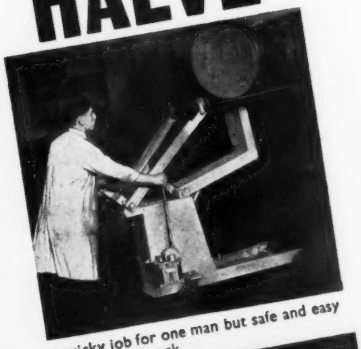
AN ALL-ROUNDER THAT SLASHES HANDLING COSTS

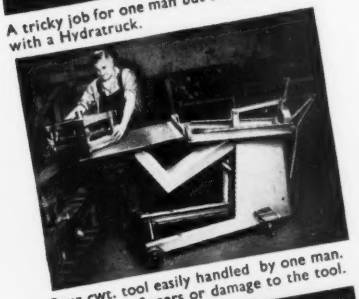
HALVE YOUR HANDLING COSTS

AND DO THE JOB BETTER, CHEAPER, QUICKER AND SAFER

The Hydratruck is unique and fully guaranteed. Loads of half a ton are lifted by hand to nearly five feet in under a minute—compare this with manhandling.



A tricky job for one man but safe and easy with a Hydratruck.



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Platform set to just the height for loading.

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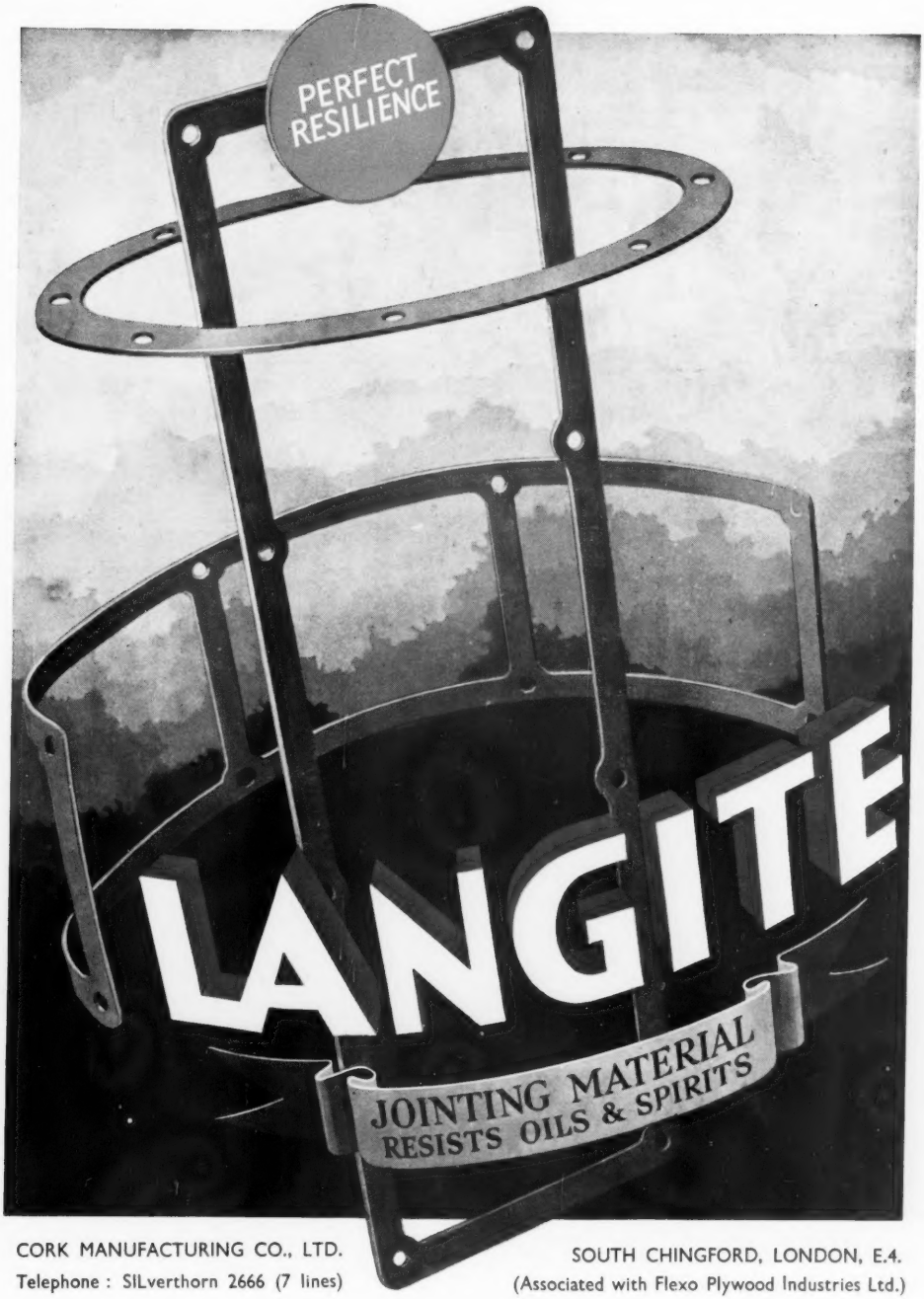

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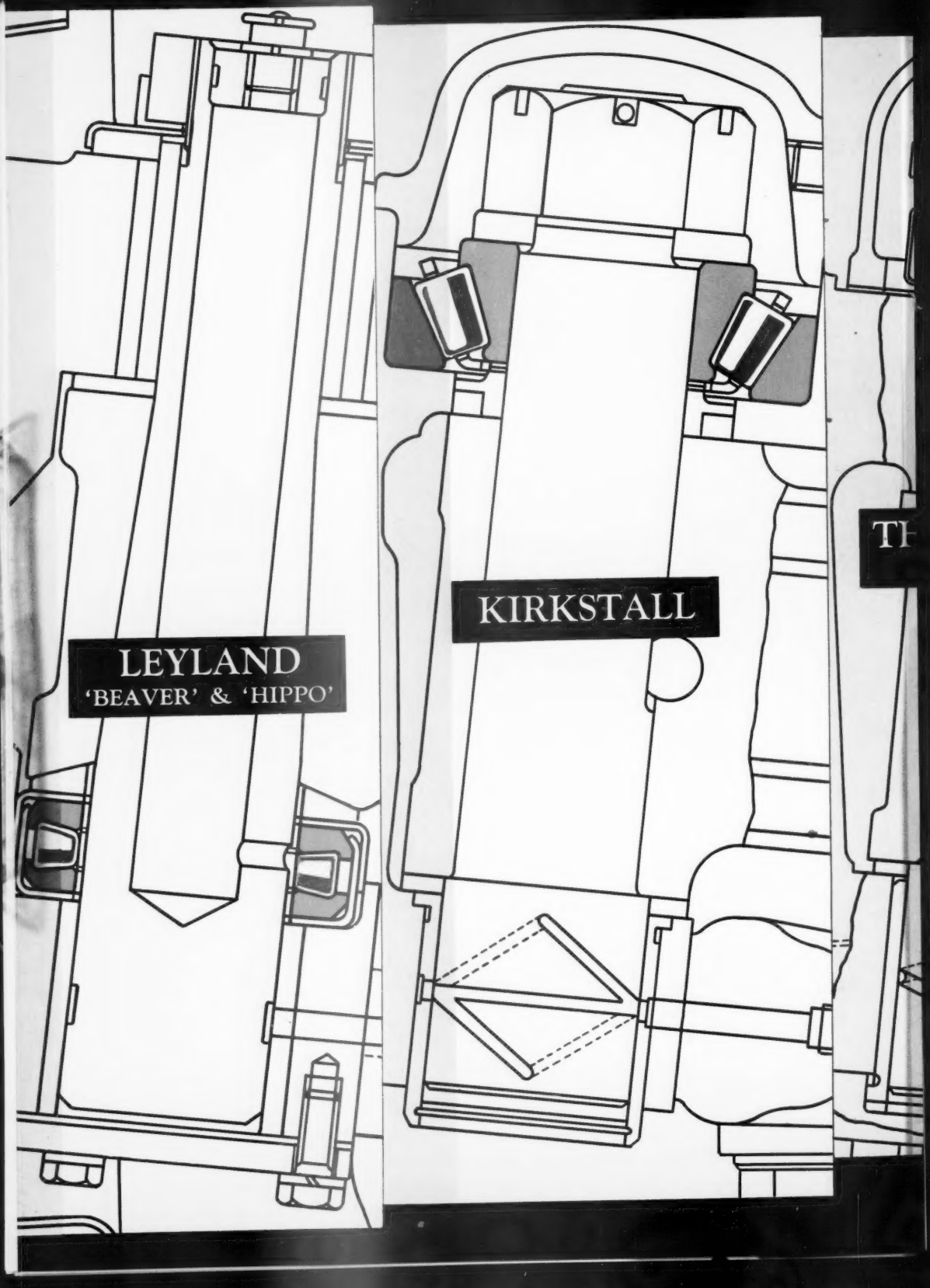
LEYLAND
'BEAVER' & 'HIPPO'
KIRKSTALL
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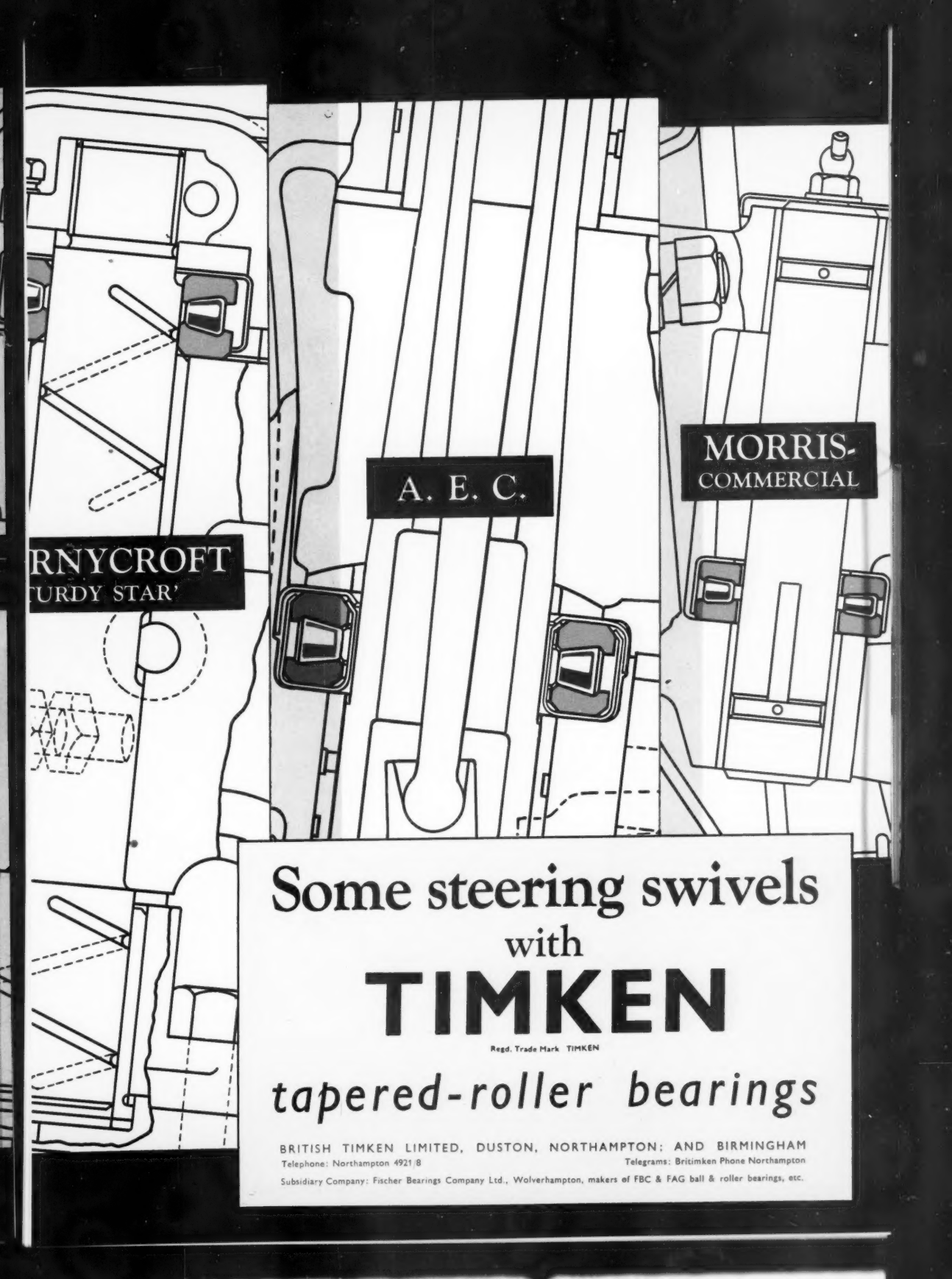

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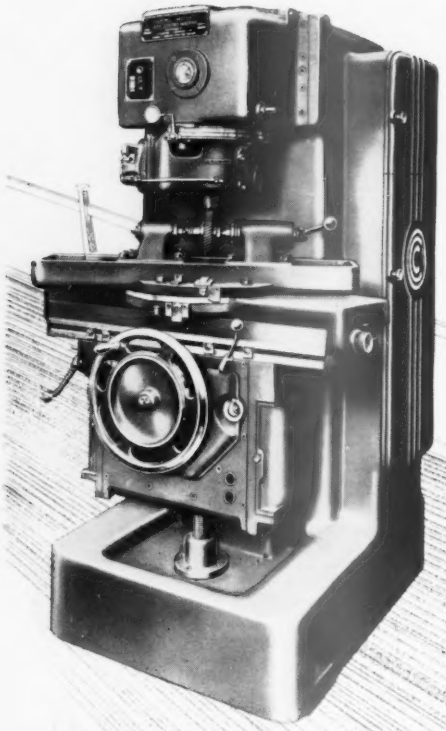

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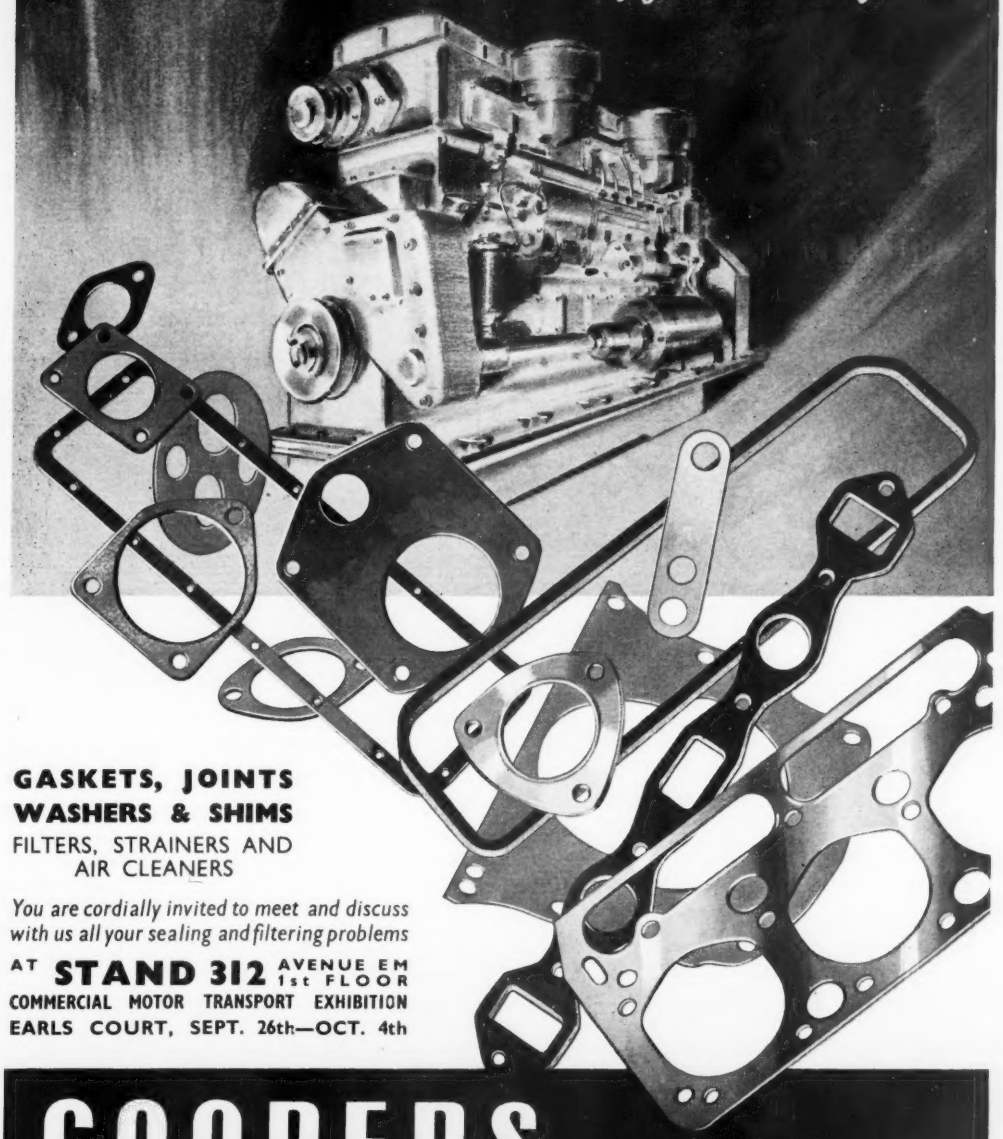
For power and efficiency



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EFFORTLESS STEERING AND GREAT DURABILITY

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Tapered roller bearings (with detachable cones on the larger sizes).

Double bearing support to rocker shaft.

End-location adjustable.

Large angular movement.

Very compact box.

For fore-and-aft or transverse layout.

Trunnion or spigot mounting alternative on heavy types.

THE 'MARLES' DOUBLE-ROLLER GEAR, made in a range of sizes covering every type of chassis.

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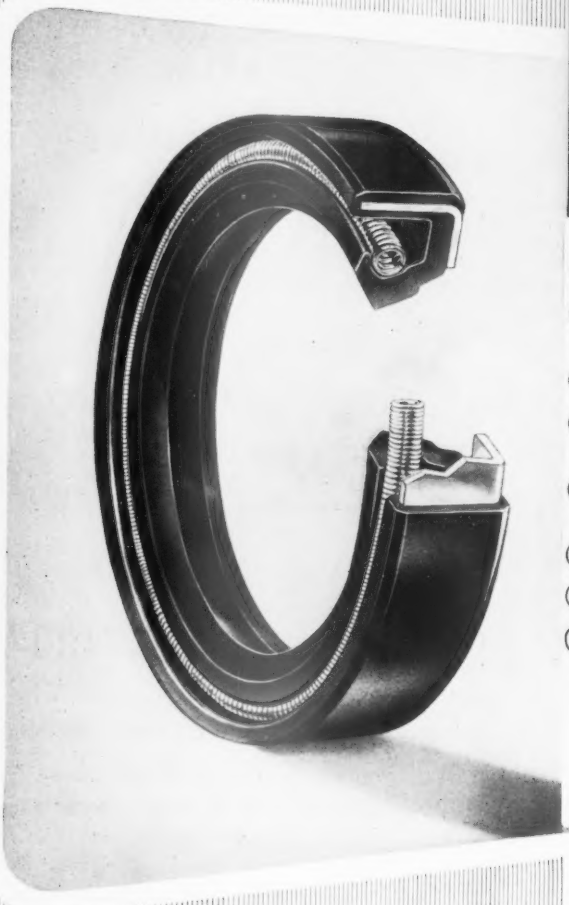

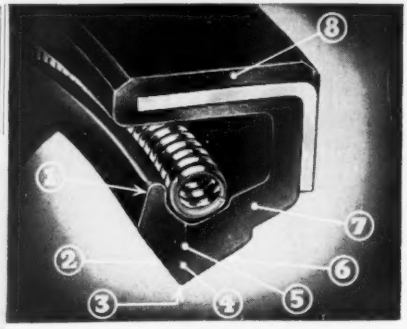

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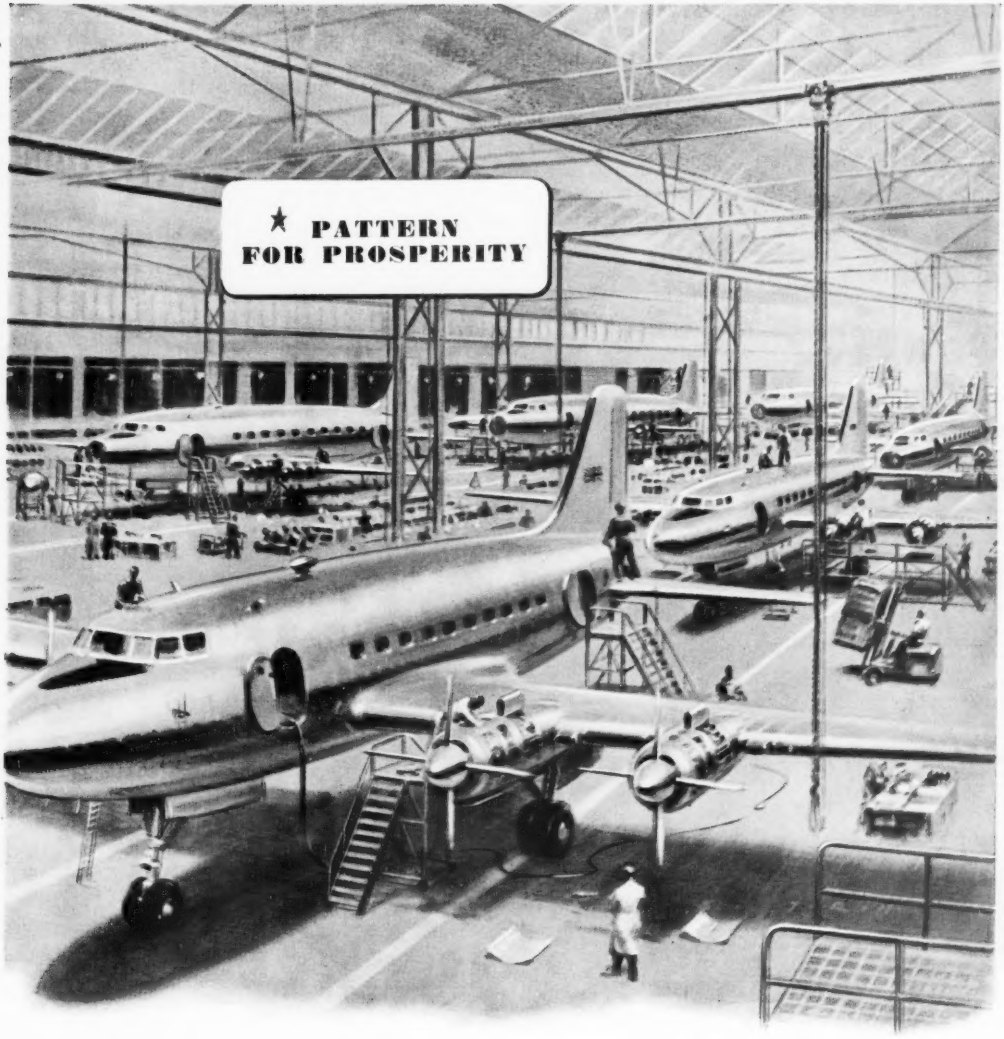


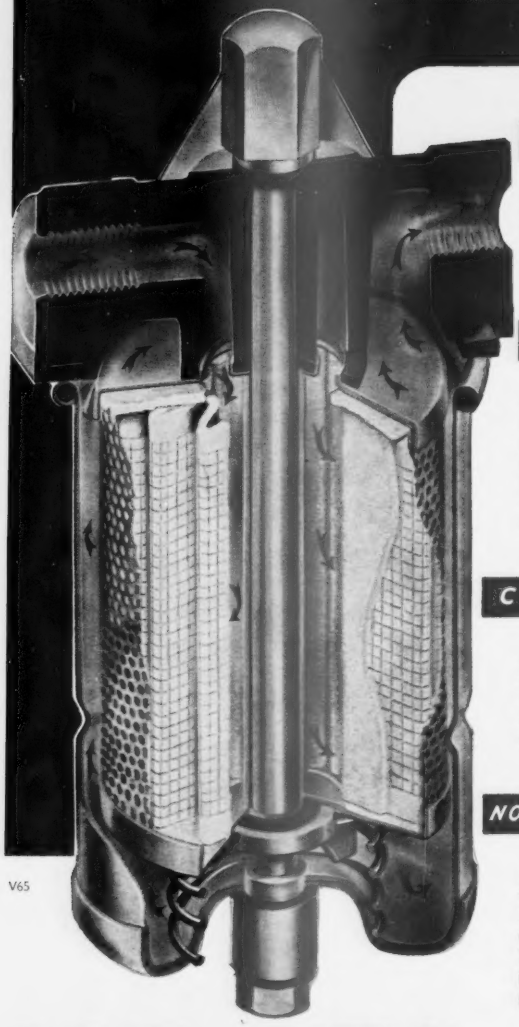
★ The rapid development of aircraft design and the ever more complex equipment which is today becoming commonplace, are making constantly greater demands upon production. Planes are taking more man-hours to build, yet output must be increased. In no other industry, therefore, is the importance of carbide tooling more fully appreciated. Large scale production in the shortest possible time means Wimet tooling to aircraft engineers, because Wimet is usually the answer to the problems they encounter in expanding the output from machine tools.

WICKMAN *of* COVENTRY

Wimet

258 ST

DO YOUR FILTERS ANSWER EVERY ESSENTIAL REQUIREMENT?



V65

FILTERING ALL THE OIL ALL THE TIME

Only a full flow filter can give real engine protection. This fact is today almost universally acknowledged—yet even a so-called full flow filter must match up to all these requirements :—

FILTRATION IN DEPTH

The VOKES element filters not only on the surface plane but, to a certain predetermined extent, *into the depth of the felt fabric itself.* This gives much greater efficiency in arresting *all* particles large enough to cause damage or wear and, even more important, ensures a build-up of sludge much slower than would be the case with an element providing surface filtration only.

CLEANABLE ELEMENTS

The policy of expendable elements may be satisfactory if spares are always available, but what happens if a machine in some remote place is prevented from working because no spares are available? VOKES filter elements can always be cleaned—a feature which ensures economy in the long run.

NON-RECIRCULATION OF TRAPPED SLUDGE

In the VOKES principle, filtration is from the INSIDE to the OUTSIDE, which means that all the sludge is trapped in the centre of the filter element and cannot in any circumstances be recirculated.

Yes! . . . in thirty years, nothing has been found to improve on the basic principles of VOKES filtration for all round efficiency.

VOKES

Pioneers of scientific filtration

VOKES LIMITED · GUILDFORD · SURREY

VOKES (CANADA) LTD., Toronto. *Represented Throughout the World.* VOKES AUSTRALIA PTY., LTD., Sydney.

Cylinders

PAR EXCELLENCE

Cast in

CHROMIDIUM

the Perfect Cylinder Iron

MIDCYL

THE MIDLAND MOTOR CYLINDER CO. LTD., SMETHWICK, STAFFS.

FBC

ALL-BRITISH

BALL & ROLLER BEARINGS

Ball and parallel-roller Bearings

F.B.C. :: FISCHER :: F.A.G.

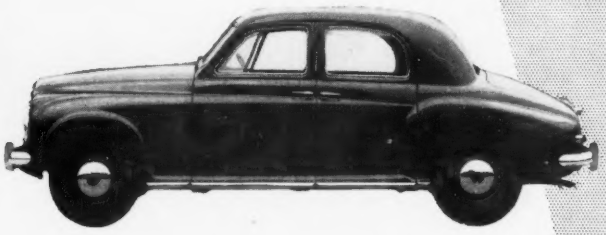
This illustration shows our sealed water-pump bearing and spindle unit on the Ford car. We make this component in several sizes.

FISCHER BEARINGS CO. LTD., WOLVERHAMPTON

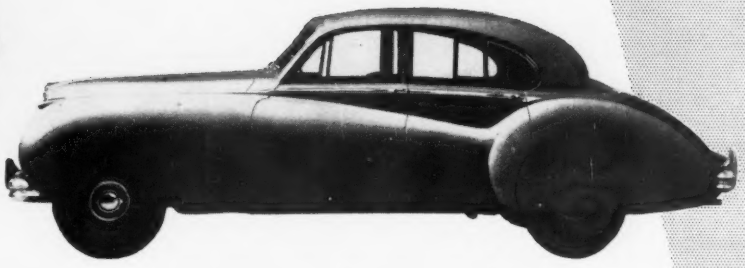
Subsidiary of British Timken Ltd.

Duston, Northampton; and Birmingham

ROVER



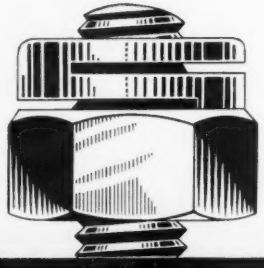
JAGUAR



The manufacturers of these outstanding cars—like many manufacturers in this and other industries —use Philidas locknuts because these are :—

- ★ *Immovable except with a spanner.*
- ★ *Unaffected by heat, vibration or the presence of oil.*
- ★ *Consistently efficient after repeated applications and removals.*
- ★ *Manufactured in the usual thread types.*
- ★ *All metal, one piece.*

Write for details of the full range of Philidas nuts.

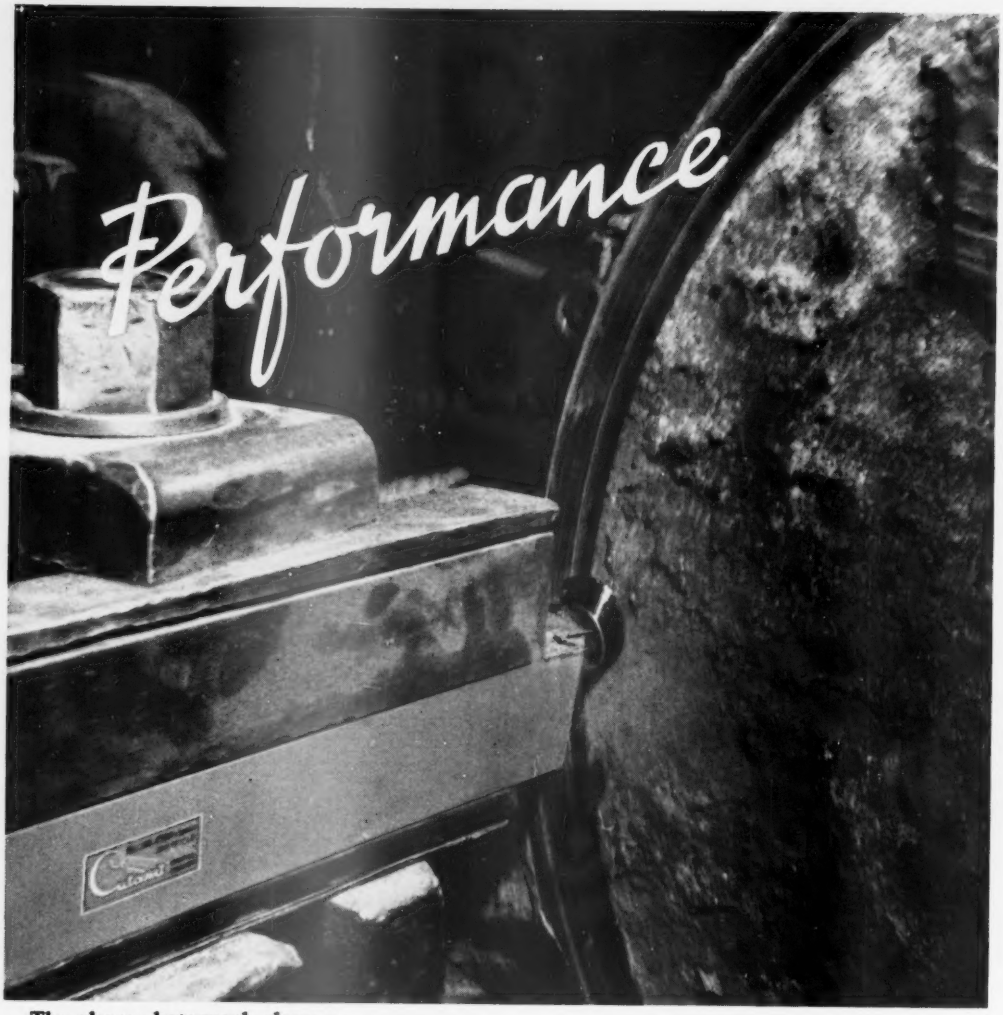


PHILIDAS self - locking nuts

Manufactured by the

PHILIDAS DIVISION OF WHITEHOUSE INDUSTRIES LIMITED

FERRYBRIDGE · KNOTTINGLEY · YORKS



The above photograph shows a heavy first cut on the rough skin of a steel casting. The tool is of Cutanit Grade R which is unequalled for this class of work.

For Maximum Performance Cut with

Cutanit
REGD. TRADE MARK
CEMENTED CARBIDE
A METRO-CUTANIT PRODUCT

Exhibiting on Stand 169
International Machine Tool Exhibition
LONDON Sept 17 - Oct 4 1952

WM. JESSOP & SONS LTD
BRIGHTSIDE WORKS SHEFFIELD

J J SAVILLE & CO LTD
TRIUMPH WORKS SHEFFIELD

THE SIGN OF QUALITY

ADD Hicycle SPEED TO METAL SHEARING

Hicycle power and reliability is now available in a portable power tool for high speed metal shearing. Conservative estimates on difficult operations show a 50% cut in operating time—a figure which is even exceeded on straightforward work. The Hicycle Shear brings dramatic advantages of power in relation to weight . . . of speed under load . . . of lower maintenance costs . . . and of electrical safety. In the Hicycle Shear you have unrivalled ease and accuracy of use with absolute taken-for-granted reliability. There is a pneumatic model for those who prefer an air tool, but whether you choose pneumatic or electric, for high speed metal shearing, it certainly pays to . . .

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CONSOLIDATED PNEUMATIC TOOL CO. LTD. - LONDON & FRASERBURGH

Offices at Glasgow · Newcastle · Manchester · Birmingham · Leeds · Bridgend · Belfast · Dublin · Johannesburg
Bombay · Melbourne · Paris · Rotterdam · Brussels · Milan · and principal cities throughout the world

27 BRITISH CAR MANUFACTURERS

USE DSP ADHESIVES—

. . . because over a number of years D.S.P. Adhesives have proved their superiority for car trim applications, and are particularly suitable to withstand tropical conditions.

As products of a subsidiary of the world-wide Dunlop organisation they are backed, as all Dunlop products are, with the hall-mark of quality.

COMMERCIAL MOTOR SHOW
EARLS COURT SEPT. 26—OCT. 4
STAND No. 425

DUNLOP SPECIAL PRODUCTS LIMITED · FORT DUNLOP · ERDINGTON · BIRMINGHAM 24

2SPC/CAS

better use—
HARRIS
GROUND THREAD TAPS

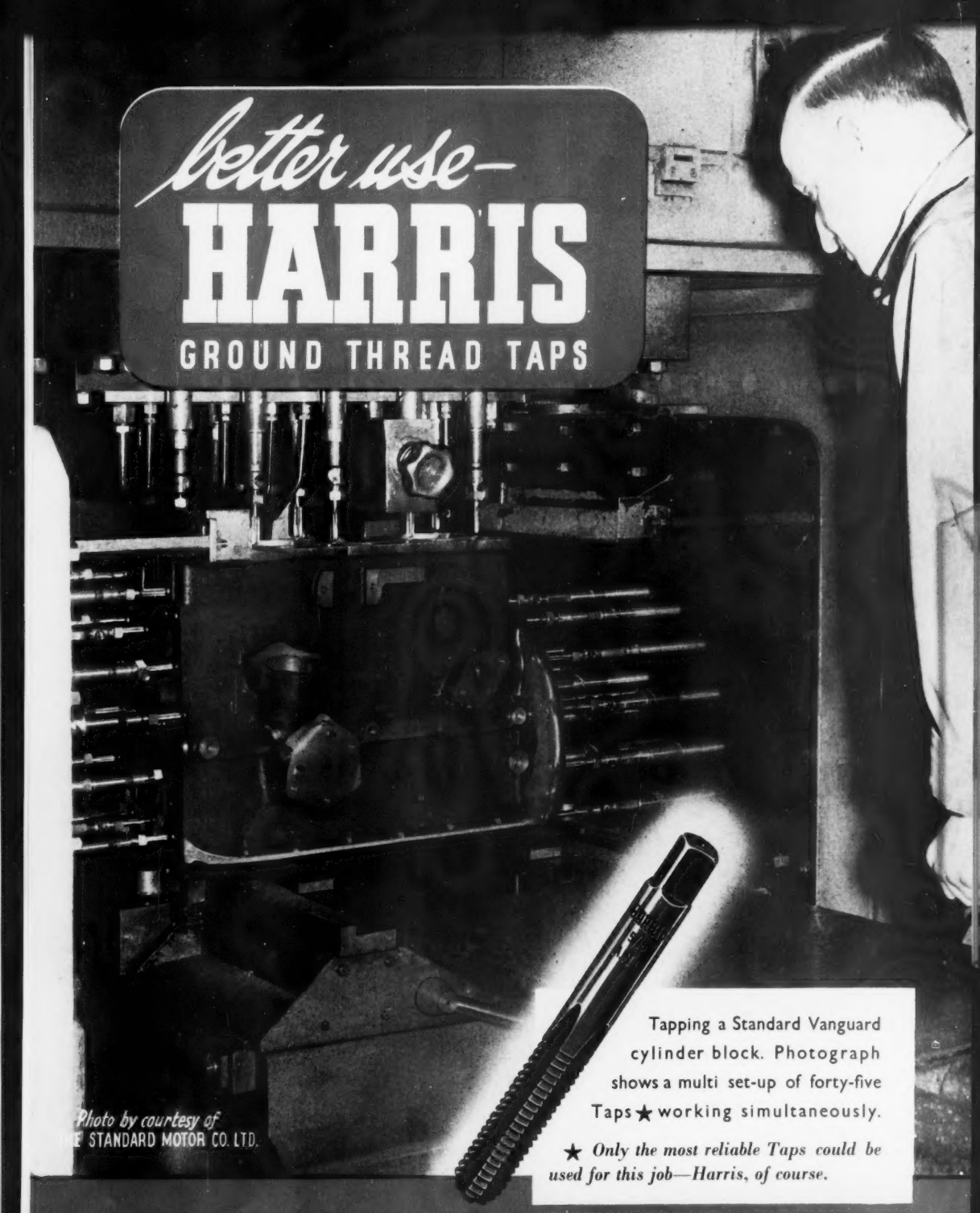


Photo by courtesy of
THE STANDARD MOTOR CO. LTD.

Tapping a Standard Vanguard cylinder block. Photograph shows a multi set-up of forty-five Taps★ working simultaneously.

★ *Only the most reliable Taps could be used for this job—Harris, of course.*

JOHN HARRIS TOOLS LTD.

WARWICK. *phone: 741 (4 lines)*

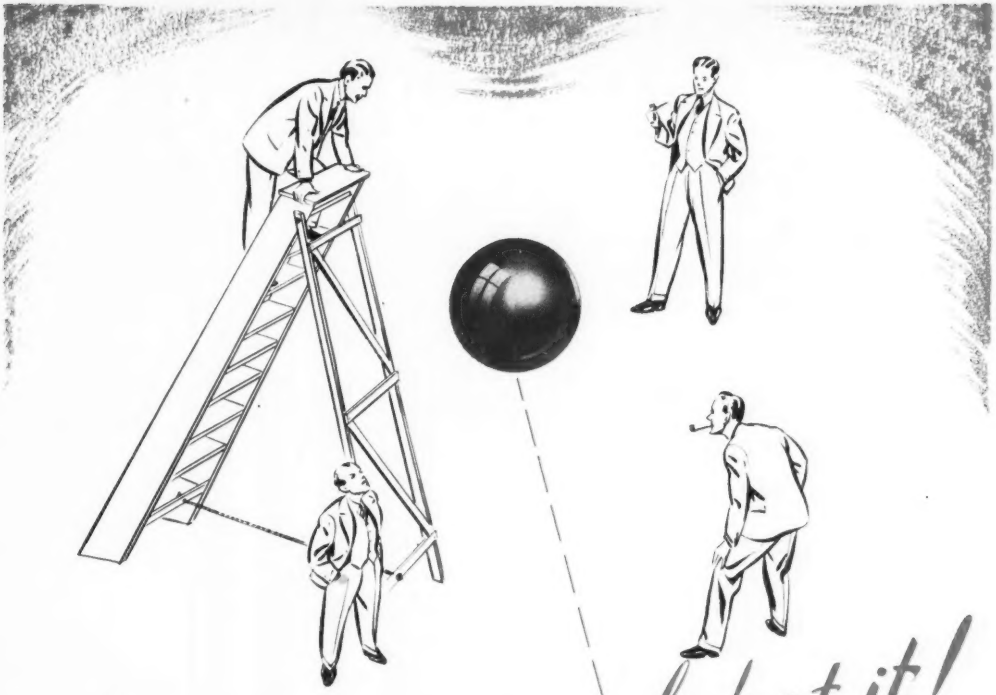
Quietly, and unobtrusively for the past 15 years, CLAYTON DEWANDRE have been manufacturing DIRECT ACTING BRAKE CYLINDERS. This aid to braking is **compact and sturdy, giving maximum performance, needs little maintenance, and has no mechanical linkage to wear or bind.**

Another example of

CD *first and foremost!*

DIRECT ACTING AIR BRAKE CYLINDERS for use with GIRLING SHOE ASSEMBLIES

CLAYTON DEWANDRE
COMPANY LIMITED
LINCOLN ENGLAND



Which ever way you look at it!

R&M Steel Balls are as near to being perfect spheres as engineering science can produce, whilst the highly polished surfaces are indicative of the accuracy of this component in R&M Ball Bearings. From the raw material, through the forging process, heat treatment and precision grinding on special machines; at each operation the skilled inspectors equipped with the most modern equipment, reject all but the perfect ball.

These exacting standards of manufacture help to make R&M Ball and Roller Bearings the nearest thing to engineering perfection today.

BALL & ROLLER R&M BEARINGS

RANSOME & MARLES
BEARING COMPANY LIMITED
NEWARK-ON-TRENT, ENGLAND

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Sept. 26—Oct. 4

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BUMPERS & OVER-RIDERS · DOOR HANDLES & LOCKS · WINDOW WINDERS · INTERIOR LIGHTING, INCLUDING LUMINATOR RANGE · STEERING WHEELS · RADIATOR GRILLES & SHUTTERS · ASH TRAYS · BONNET HINGES & LOCKS BODY MOULDINGS · BADGES & MASCOTS · LOCKING PETROL CAPS · IGNITION LOCKS · HYDRAULIC ELECTRIC DOOR GEAR

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Detachable oil filter

element easily inspected and replaced

This new AC partial-flow oil filter with replaceable element meets the increasing demand for a filter that can be removed for inspection and replaced every 8/10,000 miles. It provides a permanent installation for coupling into a by-pass oil supply system and the filtering element can be replaced without disturbing pipe connections. Sump oil is filtered on an average of ten times an hour. This means less motor wear and longer motor life — the objective of every motor manufacturer.

AC

AIR CLEANERS · AIR SILENCERS · CRANKCASE BREATHERS
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If you are contemplating an important new design, or a modification of an existing one, take advantage of the facilities of the AC Technical Bureau. We probably can save you hours of planning and experimentation. Write to the AC Technical Bureau, 54, The Butts, Coventry; or telephone Coventry 61747.

AC-SPHINX SPARK PLUG COMPANY,
DIVISION OF GENERAL MOTORS LTD.,
DUNSTABLE, BEDFORDSHIRE
and Southampton, Hants.

Delapena

The World's Best Induction Heaters

Model E12b

(6 kilowatts)

The Delapena Model E.12b High Frequency Induction Heater has been designed as a robust production tool which can be operated on a continuous basis with the minimum of maintenance.

a) Power output
   6kW on a continuous basis.

b) Remote applicator unit
   enables maximum utilisation of floor space in production line.

c) Flexible circuit
   enables wide variety of work to be undertaken.

d) Automatic voltage control
   the voltage on the valve filaments is maintained irrespective of mains fluctuations, thus enhancing valve life.

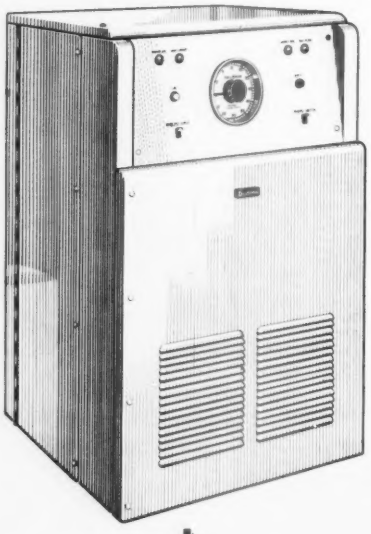
e) Simplicity of design
   Skilled labour unnecessary. Push button control.

f) High Safety Factor
   all components are generously rated.

g) Load matching
   continuous variable on-load power control provided in addition to alternative impedance matching terminals.

Other models available :

Model E.10c	...	...	...	2½ kW
Model E.15	...	...	...	15 kW

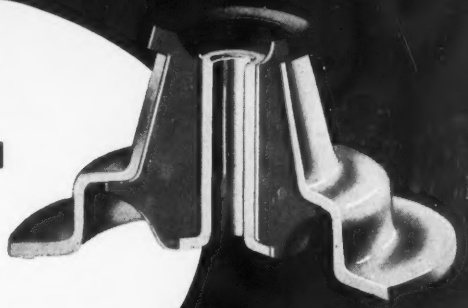


DELAPENA & SON LTD., ZONA WORKS, CHELTENHAM, ENGLAND

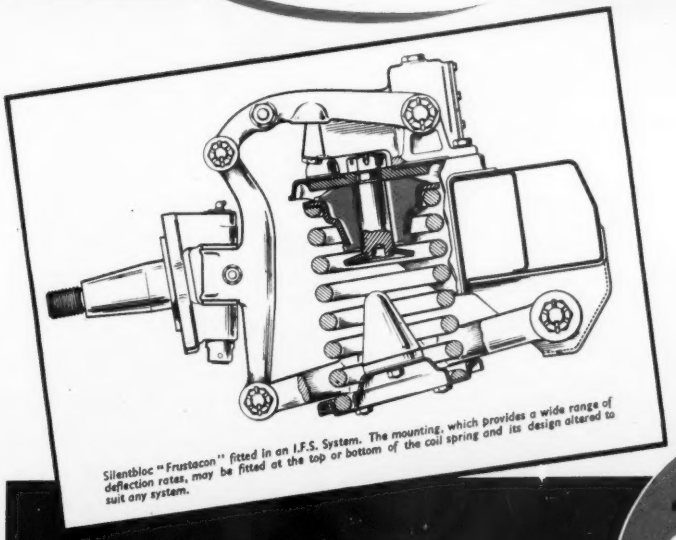
Telephone – Cheltenham 53866-7-8

Silentbloc FRUSTACON..

. . . the first scientifically designed flexible mounting fitted to the I.F.S. of a Production Car



The "Frustacon" mounting fitted to the I.F.S. of the 1952 Rover '75'. Sectioned to show rubber.



Silentbloc "Frustacon" fitted in an I.F.S. System. The mounting, which provides a wide range of deflection rates, may be fitted at the top or bottom of the coil spring and its design altered to suit any system.

To minimise the transmission of road noise to the body by the coil springs, Silentbloc Frustacon mountings have been incorporated in the I.F.S. of the 1952 Rover '75'. This notable step forward in the reduction of noise is another example of co-operation between car manufacturers and Silentbloc Ltd.

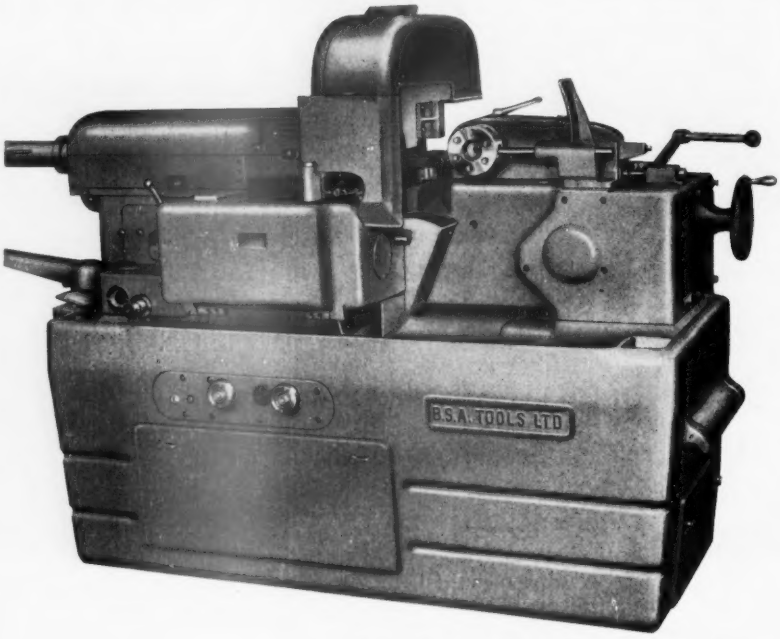
DESIGNERS AND MANUFACTURERS OF RESILIENT UNITS FOR MORE THAN 25 YEARS

SILENTBLOC LTD.

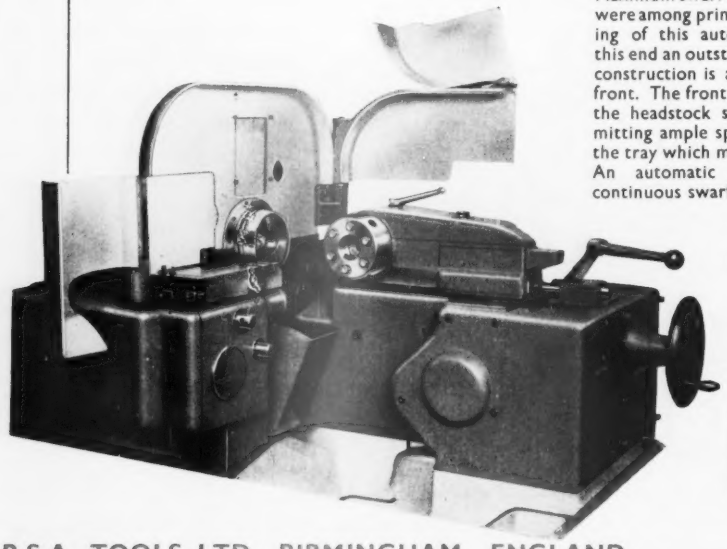
VICTORIA GARDENS

LONDON, W. 11. TEL. PARK 9821

MAXIMUM SWARF CLEARANCE & ACCESSIBILITY



ON THE BSA "L" TYPE



Maximum swarf clearance and easy access to tools were among primary considerations in the designing of this automatic screw machine and to this end an outstanding feature of B.S.A. "L" type construction is a generously proportioned open front. The front camshaft is arranged entirely on the headstock side of the cross slide thus permitting ample space for swarf to fall freely into the tray which may be emptied during operation. An automatic conveyor can be fitted for continuous swarf removal.

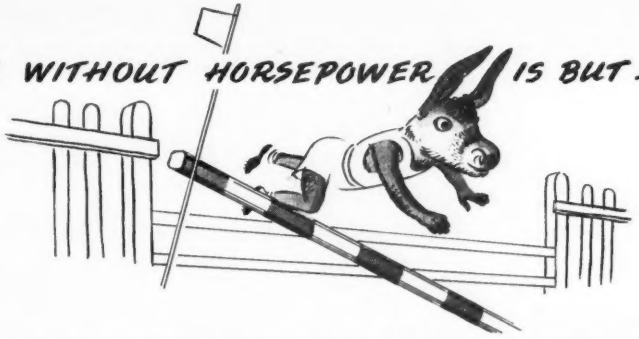
1", 1⅝" or 2" standard capacity.

Catalogue gives further details and is available on request

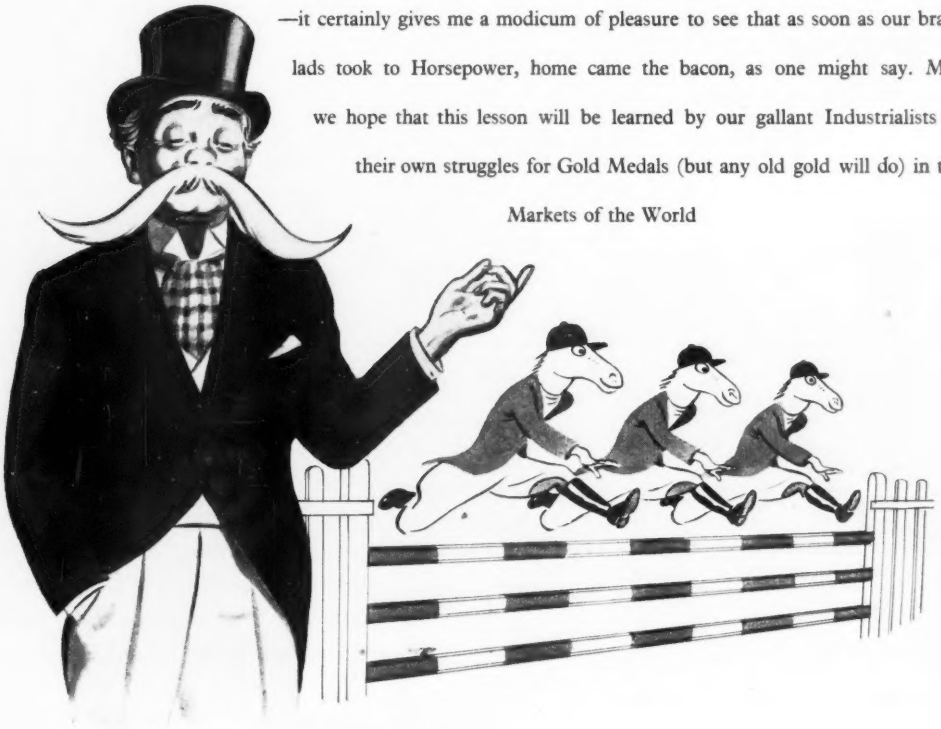
B.S.A. TOOLS LTD BIRMINGHAM ENGLAND

SOLE AGENTS IN GT. BRITAIN BURTON GRIFFITHS & CO LTD MARSTON GREEN BIRMINGHAM

MAN WITHOUT HORSEPOWER IS BUT AN ASS



Far be it from me to **gloat**—*said the M.D. in a gloating voice*—over the disappointment at the paucity of Gold Medals secured by our gallant lads and lassies at Helsinki for Running, Jumping, Twisting the Umpire, Hurling the Insult and Casting No Aspersions. **But**—*he continued, oozing self-satisfaction* —it certainly gives me a modicum of pleasure to see that as soon as our brave lads took to Horsepower, home came the bacon, as one might say. May we hope that this lesson will be learned by our gallant Industrialists in their own struggles for Gold Medals (but any old gold will do) in the Markets of the World



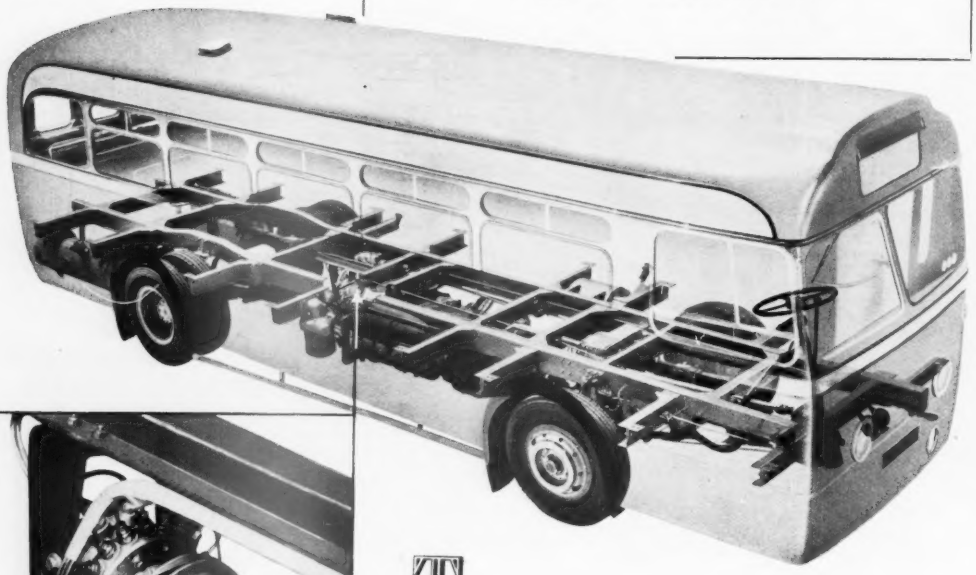
Desoutter

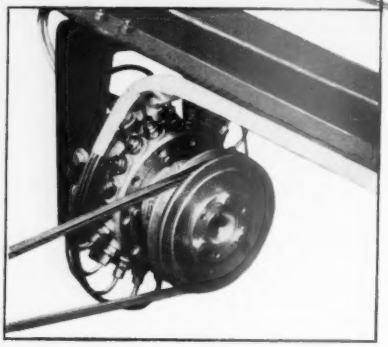
POWER TOOLS INCREASE PRODUCTION

DESOUTTER BROS. LTD., THE HYDE, HENDON, LONDON, N.W.9. TELEPHONE: COLINDALE 6346 (5 LINES). TELEGRAMS: DESPNUCO, HYDE, LONDON CRC.234

the 'Inside story' of the 'Syndromic'

AUTOMATIC MILEAGE CONTROLLED CHASSIS LUBRICATOR





THIS X-ray photograph of a coach is in itself unusual but the really interesting feature is the " Syndromic " chassis lubricator with which it is fitted.

This lubricator gives a predetermined and measured ' shot ' of oil to each individual bearing every mile, operating efficiently and automatically all the time the vehicle is running. Once fitted and regulated it requires no attention other than keeping the tank replenished with oil.

Now see the advantages . . . no ' dead ' time for periodical lubrication more pay loads . . . wear practically eliminated on spring shackles, king pins, steering swivels, etc.—no replacement costs.

Why not fit your vehicle with " Syndromic " automatic mileage controlled chassis lubrication ?

Let us send you full particulars of the system.

TECALEMIT

The Authority on Lubrication

PLYMOUTH, ENGLAND

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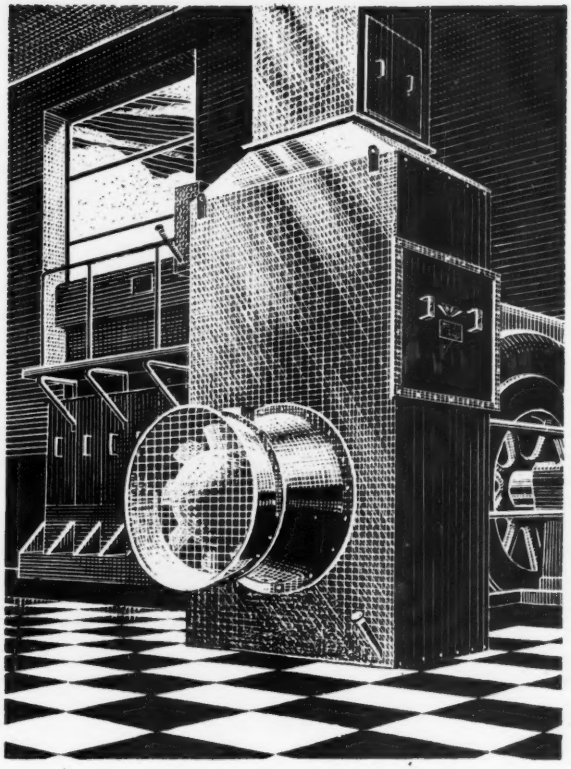

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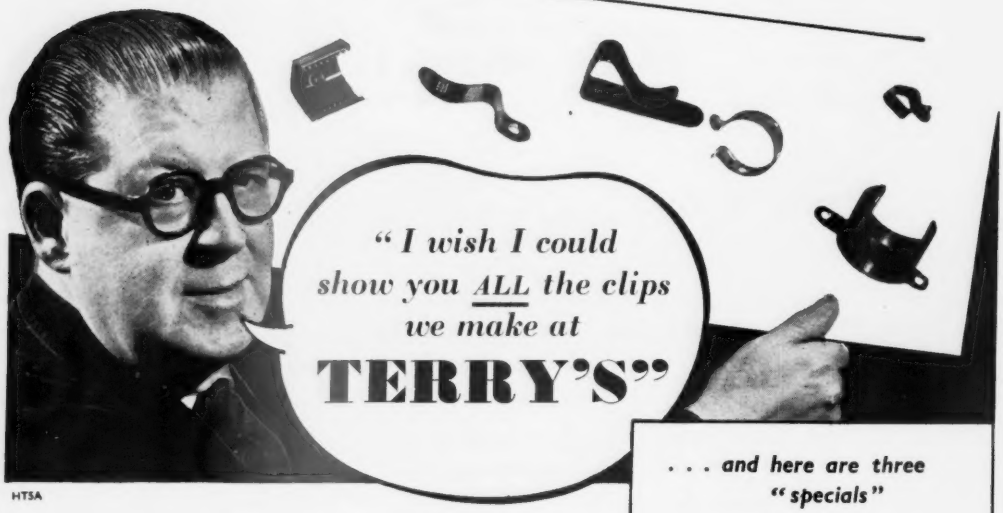
WATER COOLERS

will serve the whole needs of a factory and save 95% of the water otherwise wasted.

They are robust and compact, and can be installed in- or out-of-doors. They are extensively used for cooling the circulating water of Diesel, Gas and Petrol Engines, Refrigerating Condensers, Air Compressors, Liquid Controllers, Engine Test Houses, Process Works, etc., etc.

(The names 'Heenan' and 'Froude' are registered Trade Marks of the Company)

HEENAN & FROUDE LIMITED
WORCESTER :: ENGLAND



"I wish I could show you ALL the clips we make at

TERRY'S"

HT5A

You'd have a surprise—**CLIPS** in every possible shape and size, **CLIPS** in steel, bronze, stainless, plated, etc., **CLIPS** for every trade under the sun . . . and if you want a clip made to specification TERRY'S Research Department is there—ready and willing to give you the benefit of 96 years' experience.

Want to know all about springs?

Here's a book packed with spring know-how from cover to cover—the finest of its kind today. Post free 12/6.

. . . and here are three "specials"

Three really popular clips. Nos. 80 and 81 come ½" to 2" from stock. No. 300—an exceptionally good drawing board clip—costs 5/- a dozen (inc. p.t.), from stock.

Sole Makers: **HERBERT TERRY & SONS LTD., REDDITCH** · LONDON · BIRMINGHAM · MANCHESTER

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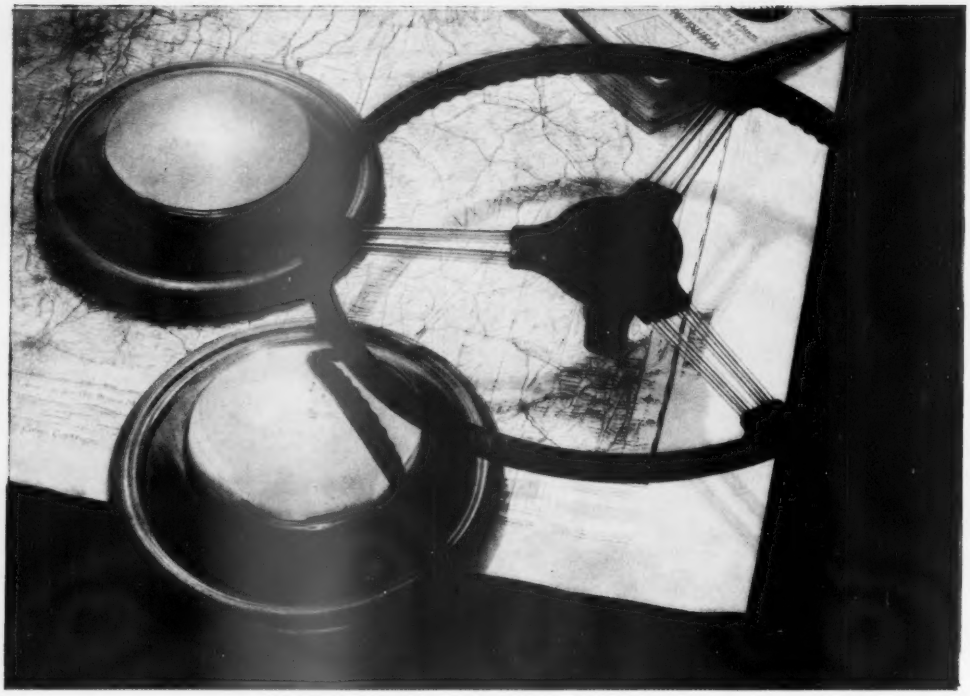


"SILVER FOX" . . . *the metal of the age*

Registered Trade Marks

STAINLESS STEEL

Motor vehicle components and fittings made of Stainless Steel cause no anxiety to the owner—the surface can never wear or peel off; the metal is stainless right through. There is no need to polish; just a wipe with soapy water and they come up bright and unspotted for the whole life of the car.

When the nation's needs permit, "Silver Fox" will be available to the discriminating motorist in ever-increasing quantities.

Our colour photograph shows Hub caps by courtesy of the Ford Motor Company. Steering Wheel by courtesy of Wilmot Breeden Limited.

THE UNITED STEEL COMPANIES LTD

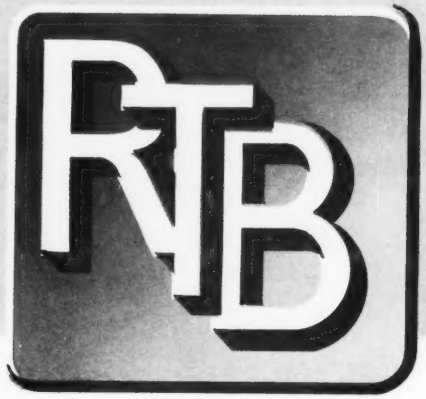
SAMUEL FOX & COMPANY LIMITED

Associated with The United Steel Companies Limited

STOCKSBRIDGE WORKS · Nr. SHEFFIELD · ENGLAND

F259

SHEET METAL FABRICATION



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in our extensively equipped press and welding shops

at Swansea and Briton Ferry

Full particulars of capacity on request from

RICHARD THOMAS & BALDWINS LIMITED

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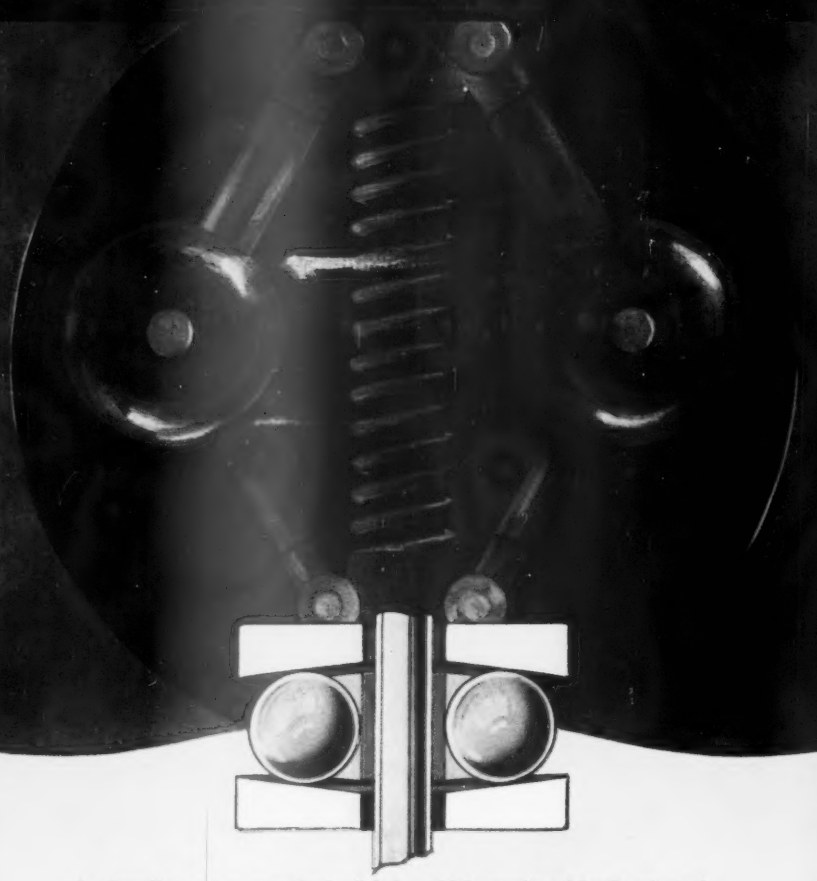


Iso-Speedic governors embody flybobs which consist of hardened steel balls rolling on ground tracks, eliminating all static friction, and resulting in a high degree of accuracy.

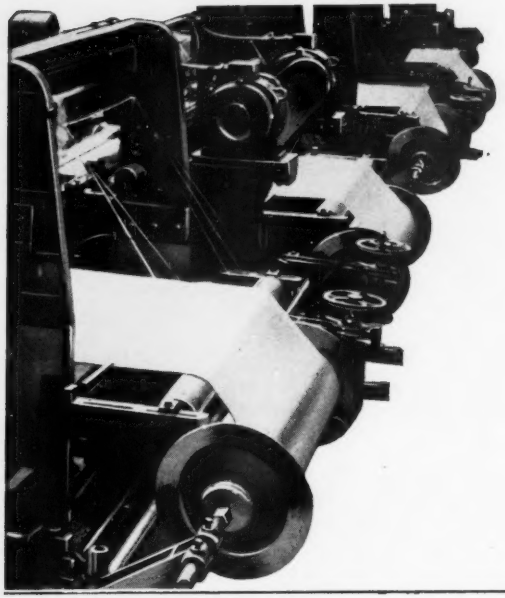
They are used on diesel engines and petrol engines, and are available for other speed control applications.

Iso-Speedic governors can be supplied which give control within 0.3% and are used on generators for radar and television. Other Iso-Speedic governors are available where a lower degree of accuracy is sufficient.

The services of our engineers are at your disposal.

Iso-Speedic

THE ISO-SPEEDIC COMPANY LTD., COVENTRY



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BIG

and the

SMALL OF IT...

BURY FELT

is at work!

Whether it is the anti-vibration base for heavy machinery, or whether it's the little felt washer on a ball-pen, Bury Felt tackles the job with confidence. This versatile material has a hundred and one different uses in industry. There are different types and textures for all kinds of work from finishing and polishing to 'safety-first' packaging. Write to us about *your* problem — it is likely that Bury Felt can solve it.

BURY FELT MANUFACTURING CO. LTD, HUDCAR MILLS, BURY, LANCS

London Offices: 3 Snow Hill, EC1 *Central 4448*

n1

Nothing down your neck . . .

Photo: Courtesy of St. Helens Corporation Transport.

On hot days you'll find none of that supercharged omnibus atmosphere you often associate with public transport. On cold days you'll find it's warm inside. Even on horrid humid days no drops of moisture collect on the roof, to splash down the back of your neck. The reason for this improved state of affairs is the 'Fibreglass' insulation, which you see here revealed. 'Fibreglass', in such uses as this, prevents condensation and modifies extremes of temperature. What's more, it's easy to apply, entirely odourless. inexpensive and . . . ready for delivery!

. . . thanks to FIBREGLASS

TRADE MARK

For structural, heat and cold insulation. Sound-deadening. Acoustic correction. Porous membranes for pipe-wrapping, flooring, roofing. Battery retainers and air filters. In textile form for electrical insulation.

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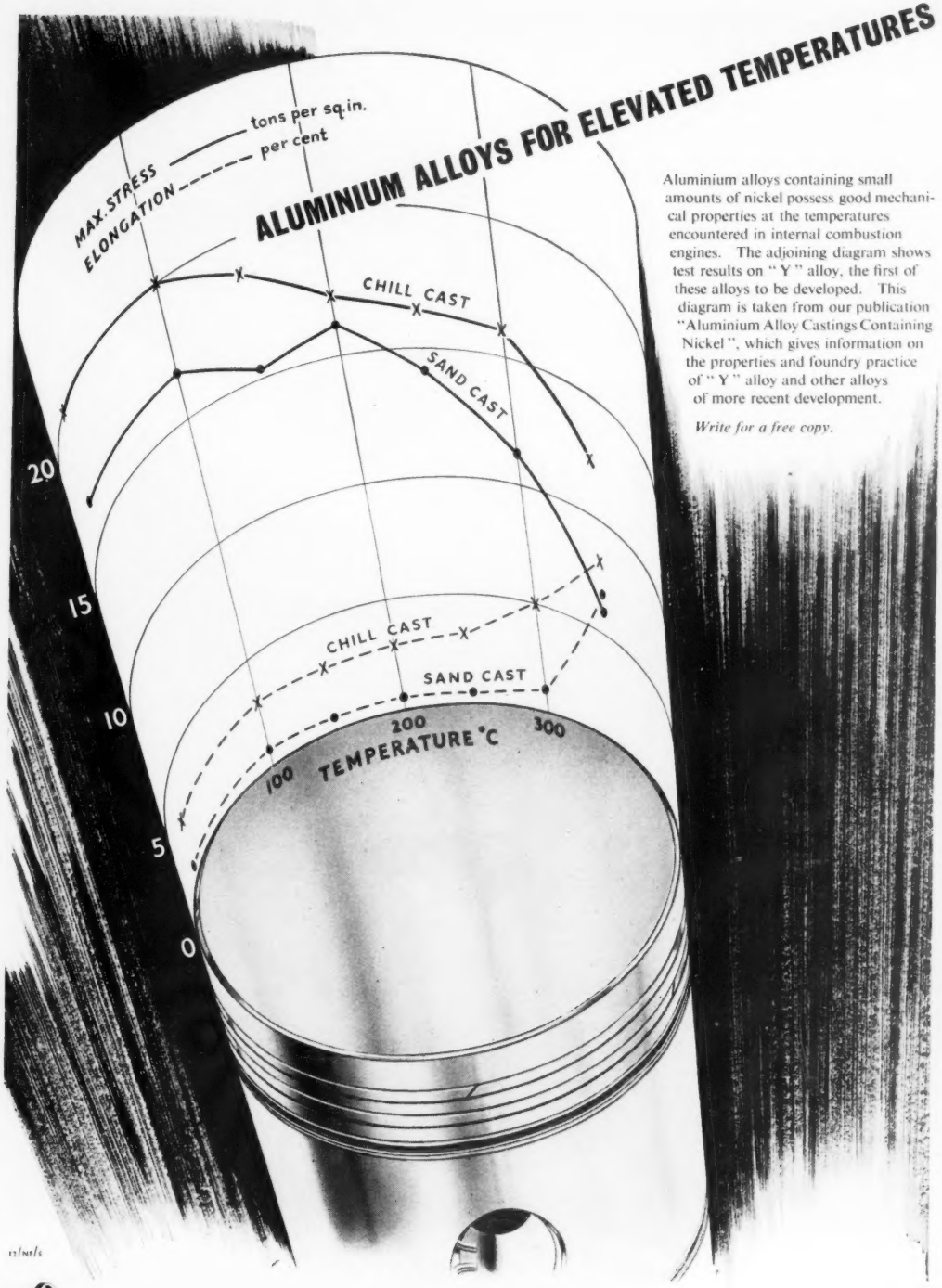
ALUMINIUM ALLOYS FOR ELEVATED TEMPERATURES



Aluminium alloys containing small amounts of nickel possess good mechanical properties at the temperatures encountered in internal combustion engines. The adjoining diagram shows test results on "Y" alloy, the first of these alloys to be developed. This diagram is taken from our publication "Aluminium Alloy Castings Containing Nickel", which gives information on the properties and foundry practice of "Y" alloy and other alloys of more recent development.

Write for a free copy.

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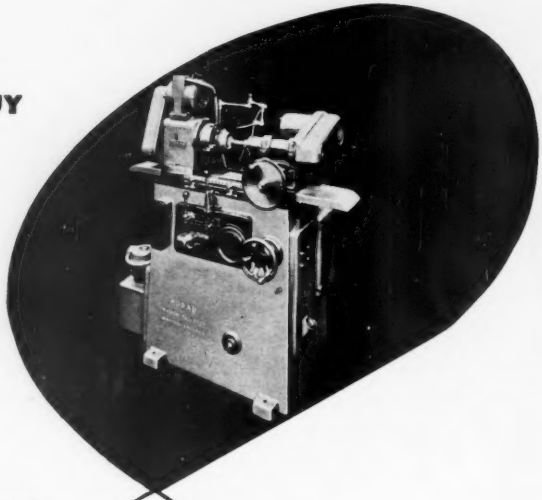
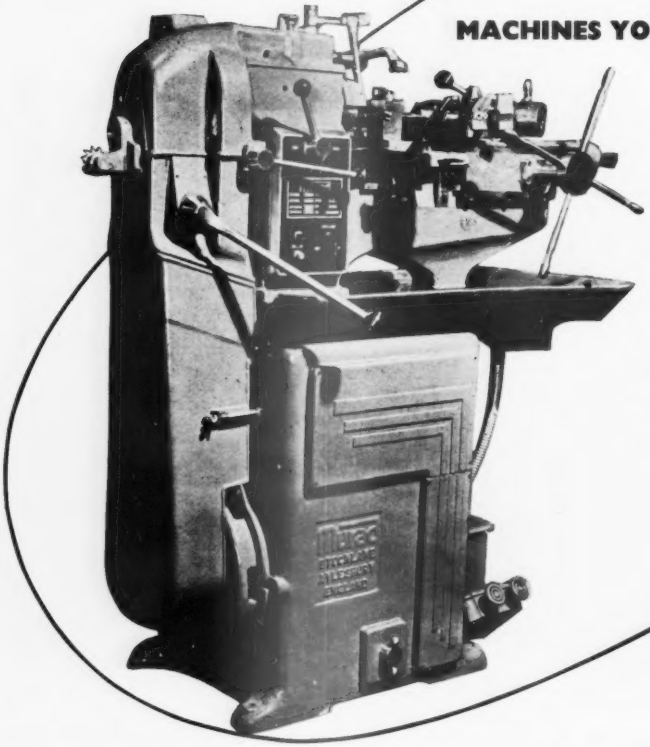
THE MACHINE YOU CAN'T BUY



We were in a hurry. Month by month
we stepped up production of our capstan lathes
and as each bottleneck appeared
we opened it.
When the internal grinding bottleneck
appeared we were "stumped."
Delivery of another grinder such as we were
using was 37 months.
So What?
Well, we set to work and designed and built
our own and it's doing its job in fine style.
Sorry! We don't propose to build
any more—not yet anyway—
too busy making capstans to meet your insatiable demand.
Later? Perhaps.

MACHINES YOU CAN BUY



Even if you can't buy
our grinder you can still buy
the MURAD 1" High Speed
Capstan Lathe. This is the machine
that holds unchallenged
leadership in the one-inch class
of capstan lathes.
That is why production
mounts week by week, month by
month and still we
can't catch up.
Full details
are yours on request.

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P 1802

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TOLEDO WOODHEAD SPRINGS LIMITED · SHEFFIELD 3

SUSPENSION ENGINEERS

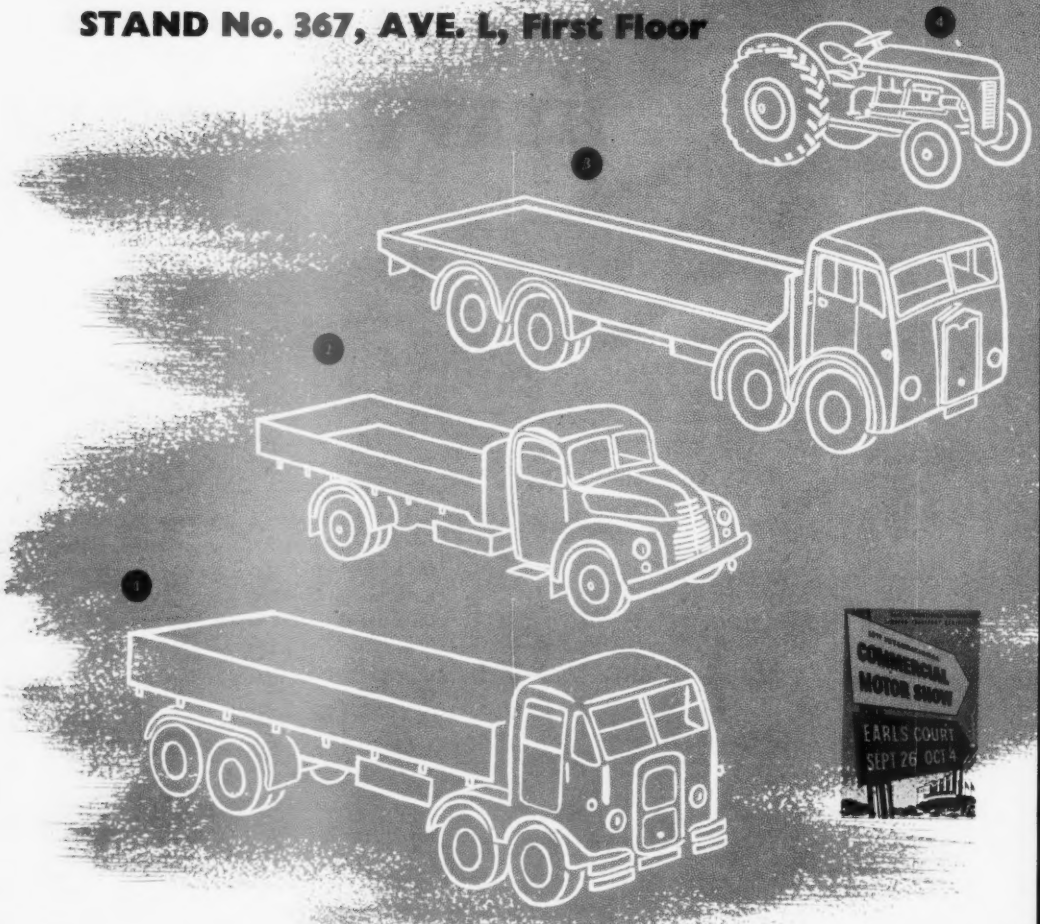
TWS 42

FIRST!.. AND

CAPASCO

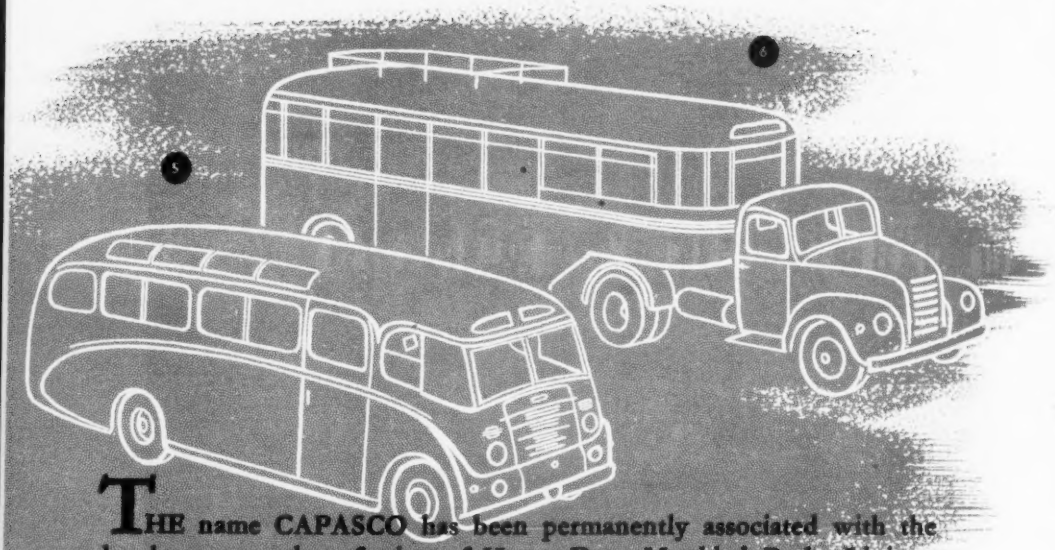
NON-FADE *Moulded* BRAKE LININGS

STAND No. 367, AVE. L, First Floor



1 Scammell 15-ton Rigid 8-Wheeler. **2** Leyland 'Comet 90' Truck Model ECO2.1R. **3** Albion 8-Wheeled Heavy Duty Vehicle. **4** Ferguson Standard Tractor. **5** Tilling-Stevens Express Type. L4MA8. **6** British Trailer Company's Airflow II 50-Seat Semitrailer Coach.

STILL FOREMOST



THE name CAPASCO has been permanently associated with the development and perfection of Heavy Duty Moulded Brake Linings right from the start.

CAPASCO pioneered the way, and is still leading this highly specialised field. CAPASCO Moulded Brake Linings are daily proving their efficiency and reliability under the most arduous conditions and in all forms of Transport.

The illustrations demonstrate clearly a few of the extensive range of vehicles to which CAPASCO is now fitted as original equipment.

★ Press Moulded Homogeneous Structure ★ High Mechanical and Impact Strength ★ Rapid 'Wet' Recovery ★ Extreme Resistance to Frictional Fade ★ Dimensional Stability ★ Uniform Wear to 'Wafer' Thickness ★ Impervious to Oil and Grease ★ Non-abrasive to Brake Drums ★ Suitable for Medium and Heavy Duty Application involving High Temperatures

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K·E HOT DIE STEELS

FOR
DIE CASTING
EXTRUDING
FORGING

Illustration by courtesy of Messrs. Enfield Cycle Co. Ltd., Redditch and Messrs. J. V. Mostert, Die Casting Engineers, Birmingham

Specially developed by our Metallurgists for gravity and pressure-fed Die Casting Dies, Hot Stamping, Pressing and Extrusion Dies and Followers, as well as for Mandrels, Containers, Bolsters, etc.

K.E. Hot Die Steels are the result of careful research into the ever-increasing demands of modern industry for steels capable of the greatest possible resistance to thermal fatigue.

Other specialities include high grade High Speed and Stainless Steels as Forgings, Wire and Bars, black rolled or precision ground to the finest limits.

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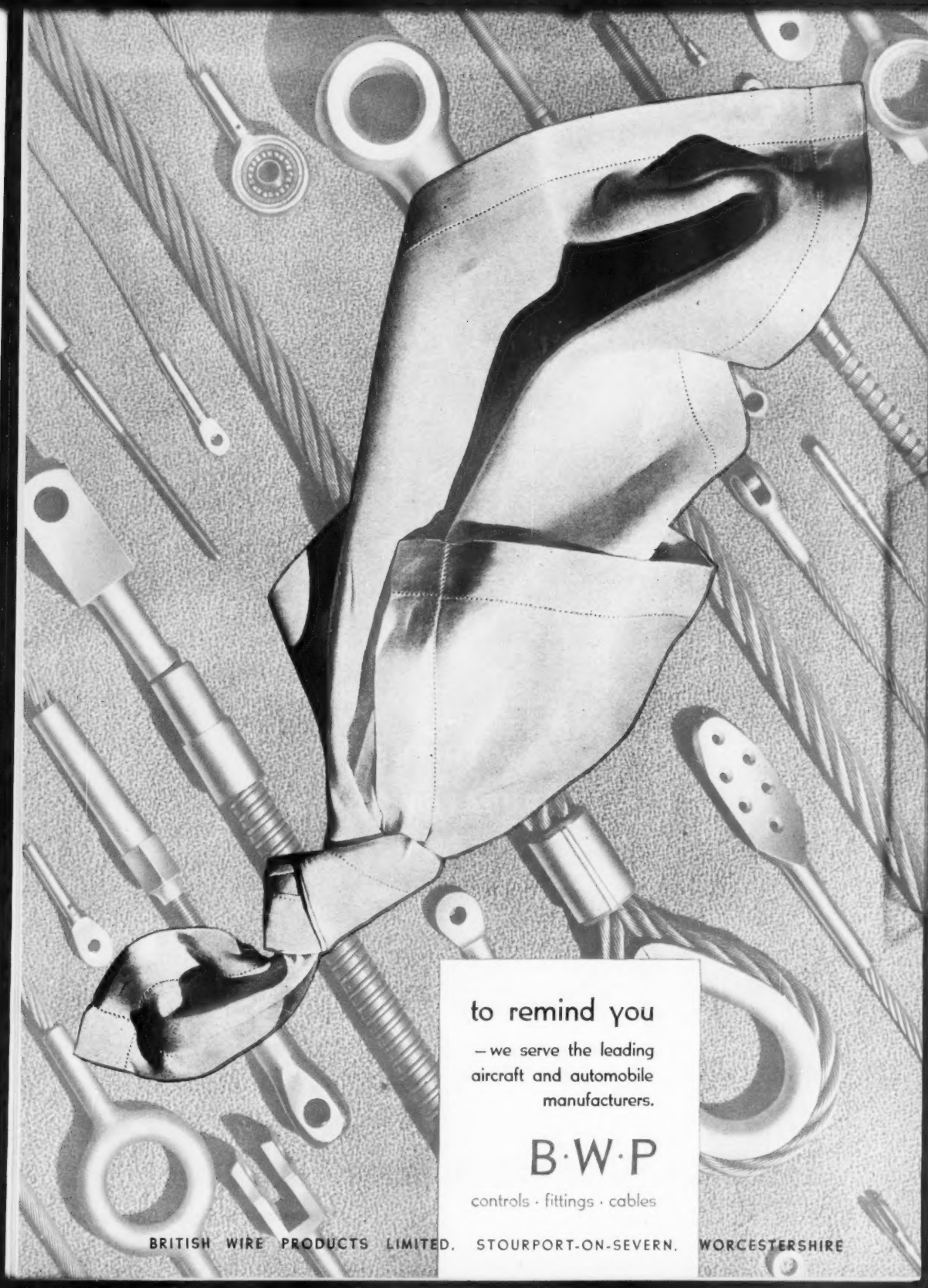
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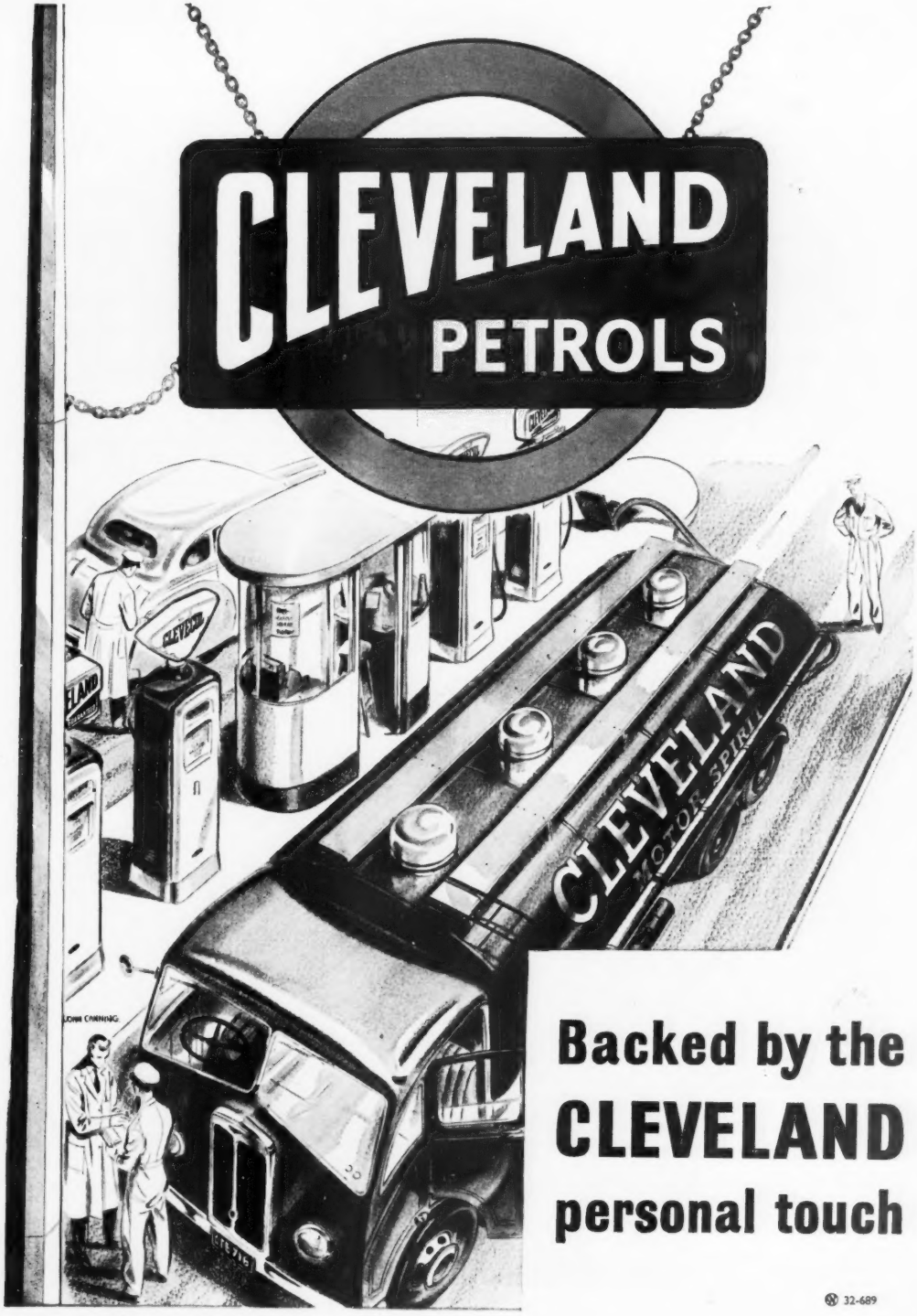
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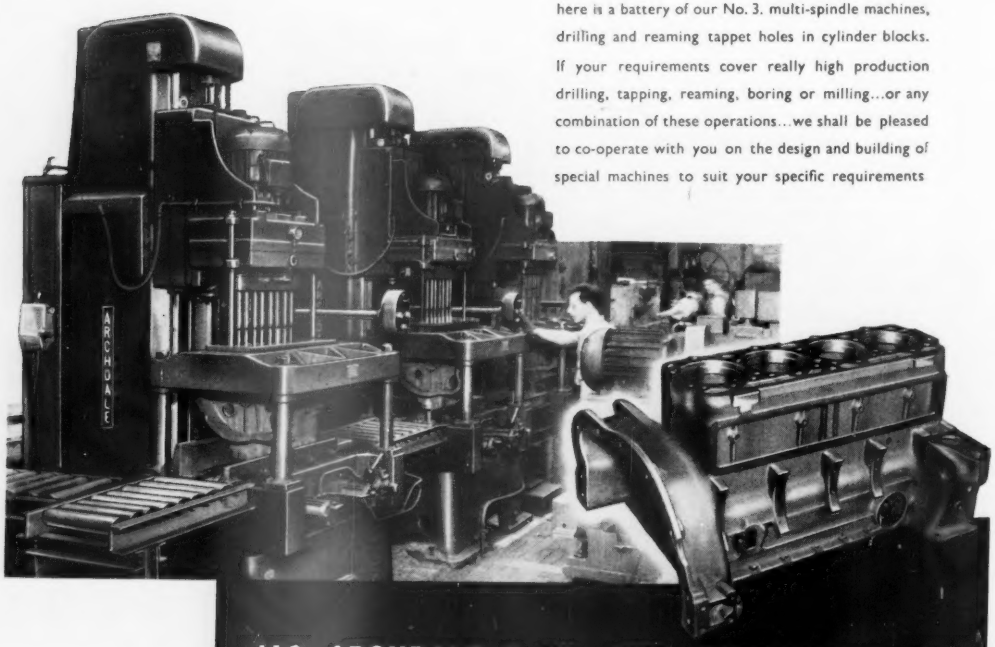
ARCHDALE special and standard machines are well represented at Ford Motor Company Ltd. on the production of the new FORDSON MAJOR tractor. And here is a battery of our No. 3. multi-spindle machines, drilling and reaming tappet holes in cylinder blocks. If your requirements cover really high production drilling, tapping, reaming, boring or milling...or any combination of these operations...we shall be pleased to co-operate with you on the design and building of special machines to suit your specific requirements



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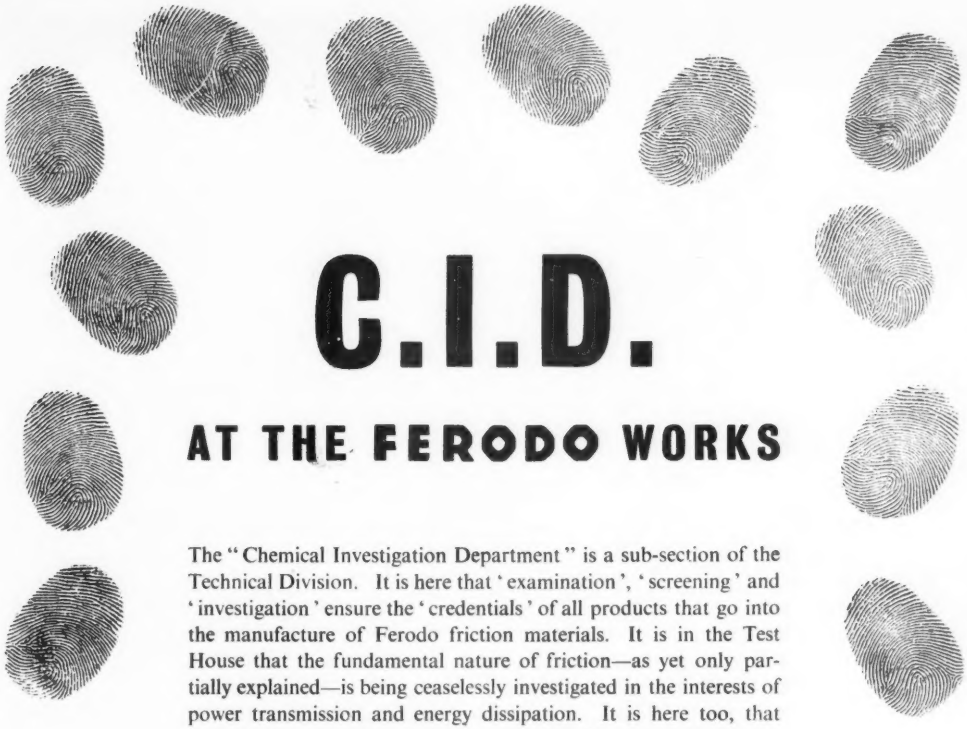

C.I.D.

AT THE FERODO WORKS

The "Chemical Investigation Department" is a sub-section of the Technical Division. It is here that 'examination', 'screening' and 'investigation' ensure the 'credentials' of all products that go into the manufacture of Ferodo friction materials. It is in the Test House that the fundamental nature of friction—as yet only partially explained—is being ceaselessly investigated in the interests of power transmission and energy dissipation. It is here too, that samples of every batch of output are subjected to drastic endurance and efficiency tests. But it is on the M.I.R.A. track (of which Ferodo Limited are one of the largest users) that the final and practical proving of the finished product takes place.

British and Overseas Automobile Engineers and Designers are freely and cordially invited to make full use of the Test House facilities so that at first hand the problems associated with ever increasing h.p. and speed can be considered, discussed and solved.

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FERODO LIMITED, CHAPEL-EN-LE-FRITH

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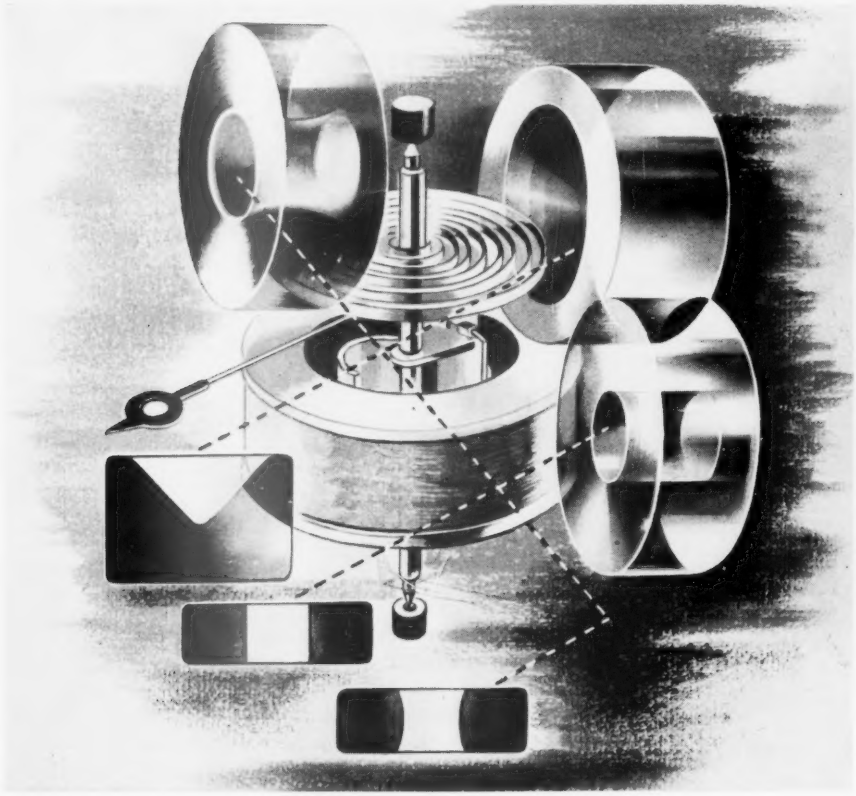

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One forty-thousandth part of an inch is the unit with which fine diamond powder is measured. With such powder sapphire and ruby are ground to produce jewel bearings for watch, chronometer and scientific instrument. Accuracy is the key note. Only diamond powders graded to close, consistent *and* fine *limits are of use.*

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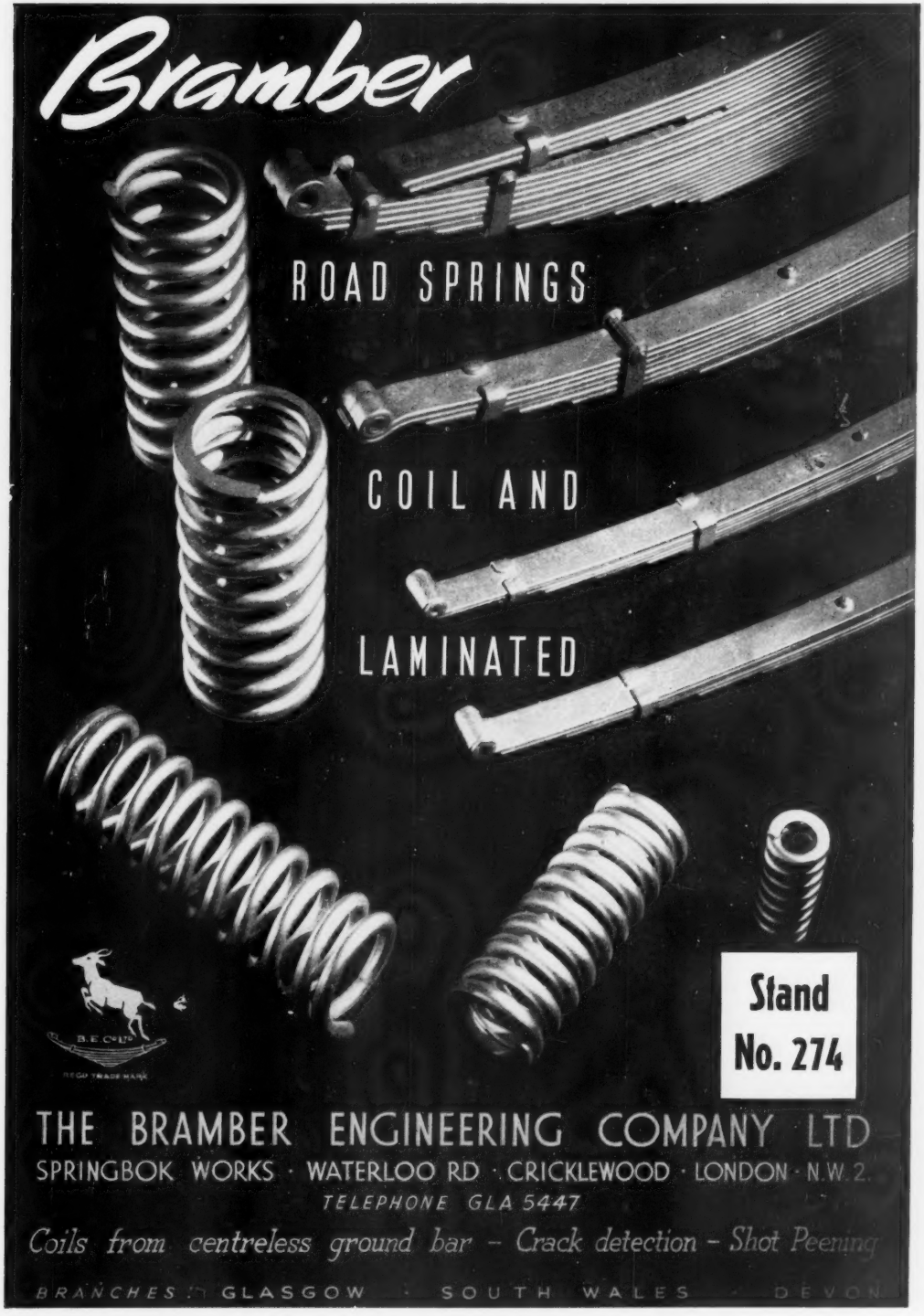
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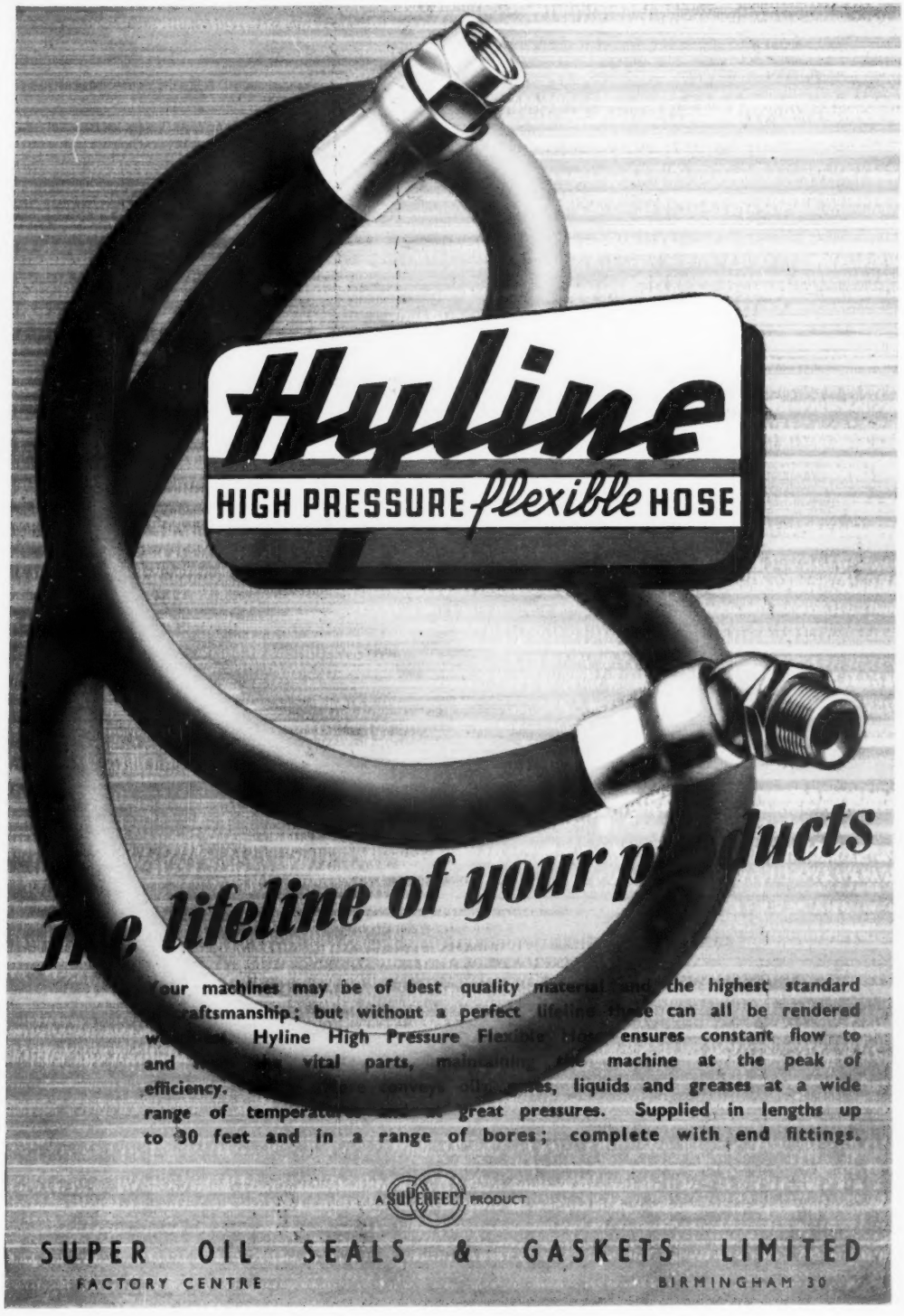
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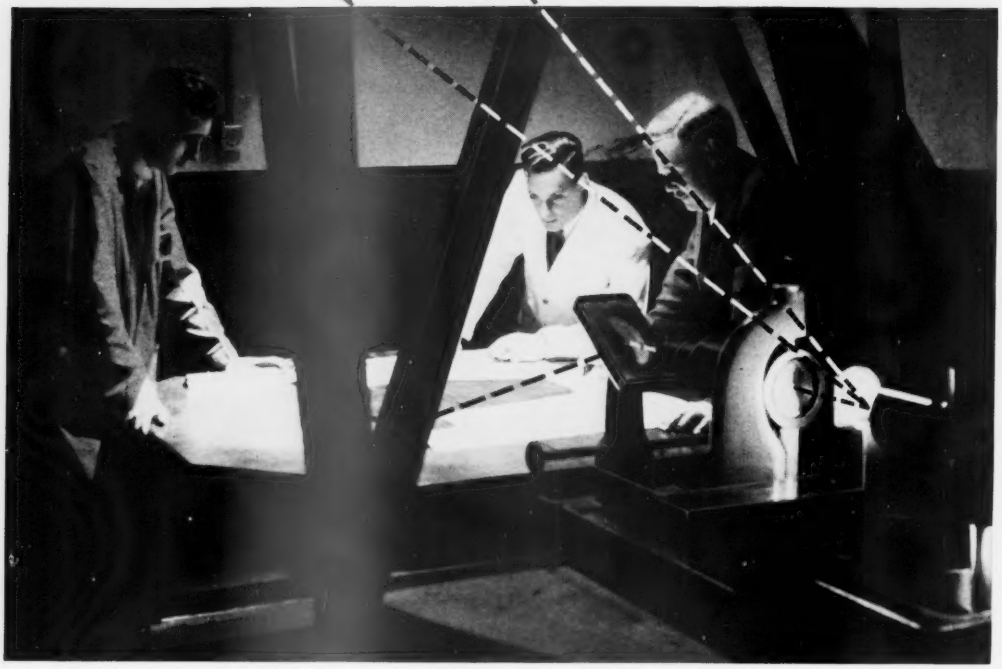
getting down to fundamentals



We keep our eyes peeled for inaccuracy all the way from the blank to the finished gear; and to help peel our eyes, we have an extensive range of gear testing equipment, much of which has been developed by ourselves. Other equipment, like the Taylor-Hobson projector illustrated, is brought in for examination of gear profiles, gauges, cutters, screw threads, etc.

In this way we keep a tight control of gearing inaccuracies and produce gear as right as rain.

Holroyd WORM GEARS

JOHN HOLROYD & COMPANY LIMITED · MILNROW · LANCASHIRE

CBC 156

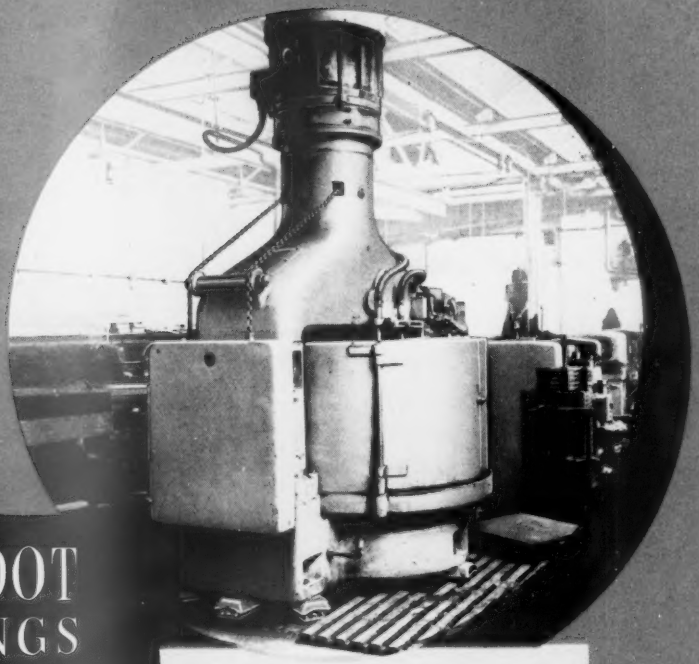
Specifying for high-temperature plant a metal which will not last is wasteful and costly. But equally it is wasteful to choose one material when a cheaper alternative would be successful. That is where we can help. We have research data and service results covering uses of many materials in many types of operating conditions, and shall be glad to assist you to choose the material to meet your specific problem. The chances are that one of our high-nickel alloys will provide the solution but ask us *before* you go ahead.

WIGGIN

FOR COLD FACTS ON HOT METALS

HENRY WIGGIN AND COMPANY LIMITED · WIGGIN STREET · BIRMINGHAM · 16

The battle against Vibration



CUSHYFOOT MOUNTINGS

Increasing accuracy of grinder

This Lumsden Grinder, used by Mellor Bromley Ltd., Hosiery Machine Manufacturers, Leicester, is mounted on eight "Cushyfoot" units. In addition to preventing the transmission of vibration from one machine to another, the mounting has been found to eliminate wheel shudder.

These mountings are very easily fitted and are extremely compact, raising the machine only 4 inches, and carrying weights from 5 cwt. to 1 ton per unit.

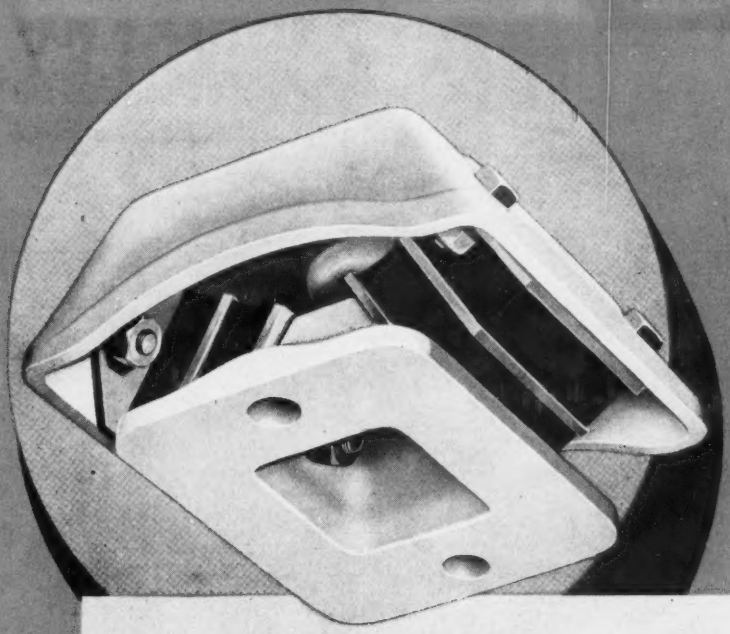
They provide resilience in every plane, normally with the same stiffness in every direction, but—when required—with greater stiffness in one direction, for example to resist thrust or belt-tension.

The construction embodies the characteristic use of rubber in shear and compression with the famous Metalastik rubber-to-metal weld.

Approximate dimensions of the unit :—
Height $4\frac{1}{4}$" unloaded. Width 8", Length 9", Weight 23 lb.

METALASTIK

METALASTIK LTD., LEICESTER



Underneath view of the smaller 'Cushyfoot' unit

. . . a little sister to 'CUSHYFOOT B'

' Cushyfoot ' mountings, so easily fitted under the pedestals of machines, have been widely adopted on account of their spectacular alleviation of the effects of vibration, both on personnel and machines.

In response to an increasing demand, we are now making a smaller size 'A' which can be supplied to suit loads for 200, 300, 400, 600 or 800 lb. and having a height when loaded of approximately $2\frac{5}{8}$". The original ' B ' size with a loaded height of approximately $4\frac{1}{8}$" is still available for loads of 600, 1200, 1800, 2400 or 3500 lb.

' Cushyfoot A' is compact, simple and weighs only 5 lb.; it is easily installed and has all the valuable properties of its big brother, utilising rubber-in-shear and the famous Metalastik rubber-to-metal weld, in the classical manner which has made vibration-proof history.

CUSHYFOOT

METALASTIK

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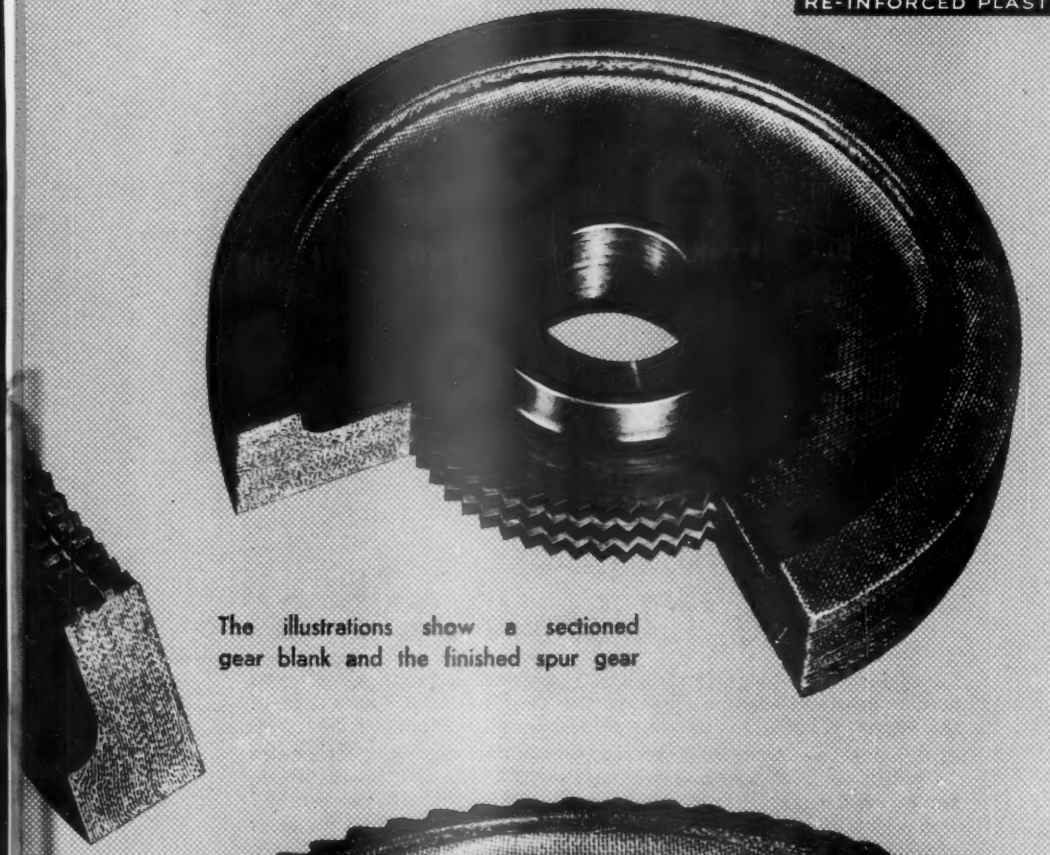
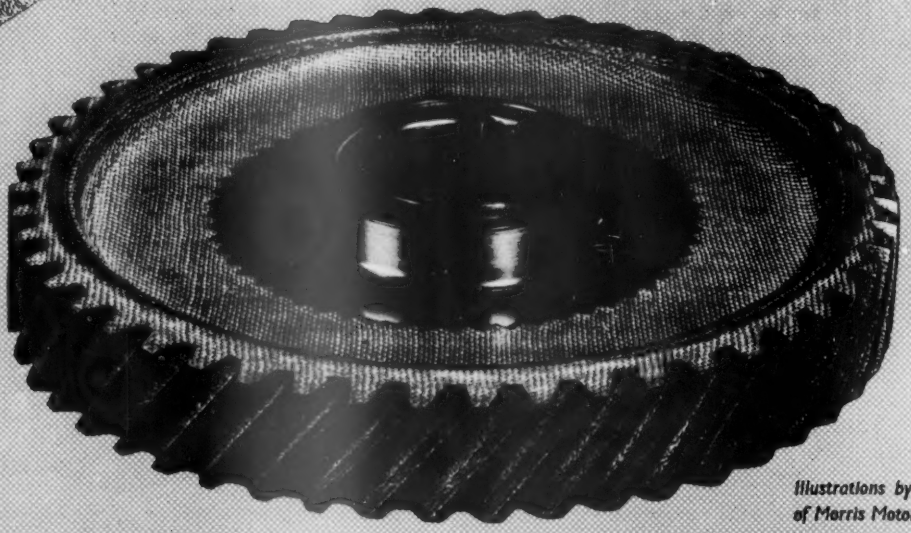
RE-INFORCED MOULDINGS

better in TEXOLEX

RE-INFORCED PLASTICS



The illustrations show a sectioned gear blank and the finished spur gear

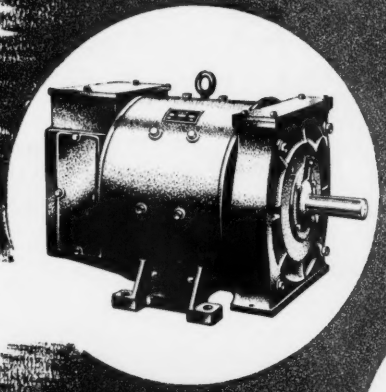


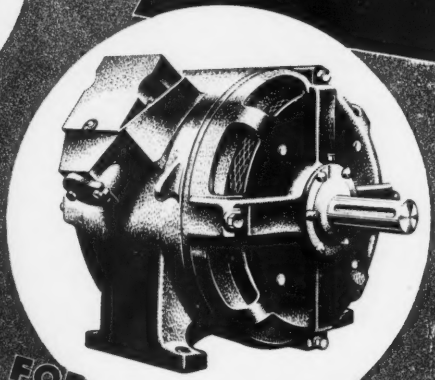
Illustrations by courtesy of Morris Motors Limited

THE BUSHING CO. LTD., HEBBURN-ON-TYNE

THEY BEAR THE NAME

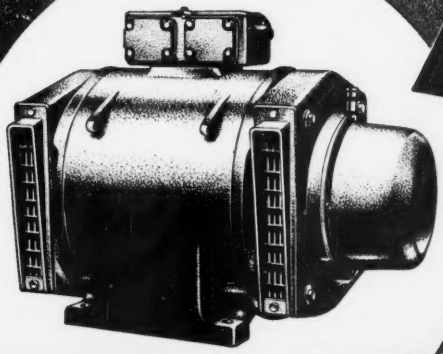
G.E.C.





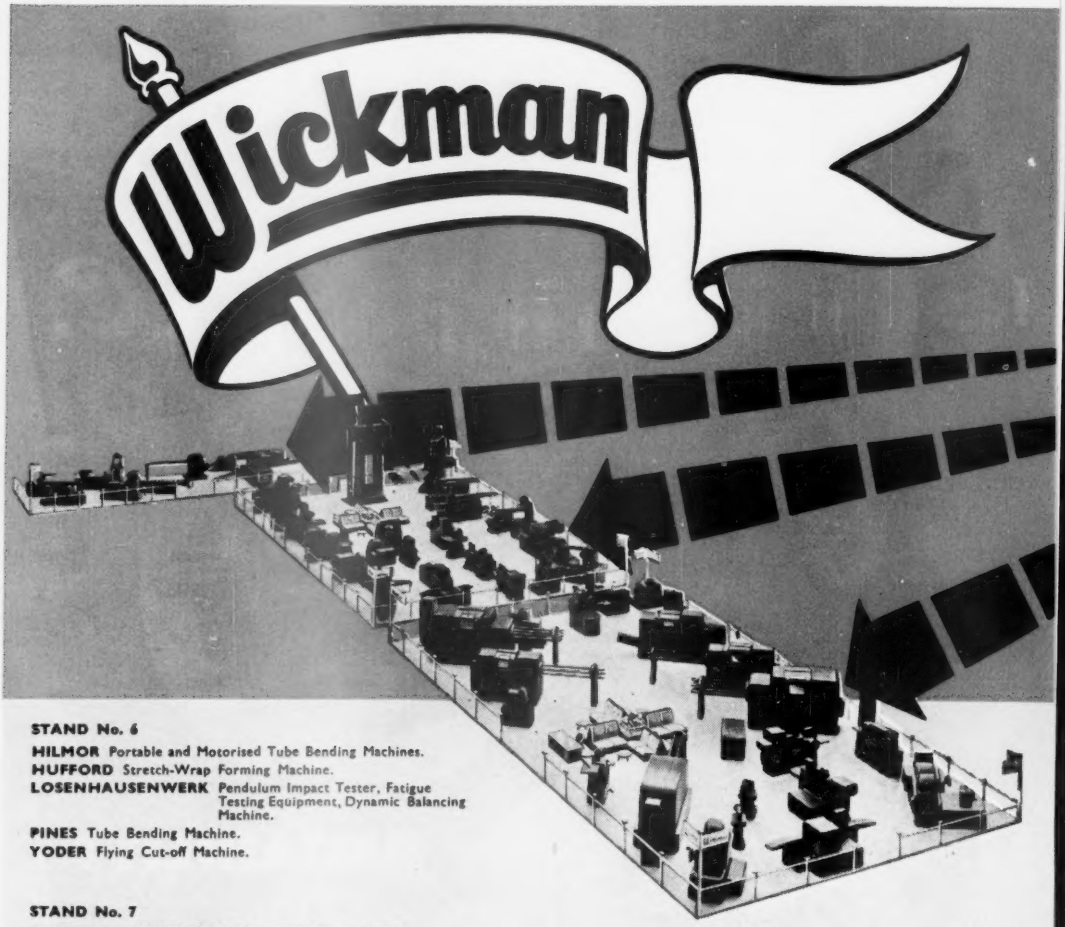
. . . AND A NAME FOR

RELIABILITY



G.E.C. STANDARD INDUSTRIAL MOTORS

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2



STAND No. 6

HILMOR Portable and Motorised Tube Bending Machines.
HUFFORD Stretch-Wrap Forming Machine.
LOSENHAUSENWERK Pendulum Impact Tester, Fatigue Testing Equipment, Dynamic Balancing Machine.
PINES Tube Bending Machine.
YODER Flying Cut-off Machine.

STAND No. 7

COLLET & ENGELHARD Horizontal Boring Machine.
HABERSANG & ZINZEN Multi-spindle Drilling Machine.
HELLER Piano-milling Machine, Horizontal Milling Machine, Ending and Centring Machine, Automatic Cold Saw, Special Boring Machine.
HERLAN Extrusion Press.
H.P.M. 75 Ton Tapering Press.
KLOPP Hydraulic Shaping Machines.
KOPP Keyway, Slot, Spline and Profile Milling Machines, Circular Table Milling Automatic.
LEBLOND Toolroom Lathe.
LORENZ Gear Hobbing and Gear Shaping Machines.
WARNER & SWASEY Radial Tapping Machine, Universal Turret Lathe.
WEIPERT S.S. and S.C. Lathe, Production Lathe.

STAND No. 8

WICKMAN Multi-spindle Bar and Chucking Automatics, Optical Profile Grinding Machine, Sliding Head Precision Automatics.
WICKMAN-MOULTON Thread Milling Machine.
LIDKOPING Centreless Grinding Machine.
NAXOS-UNION Universal Grinding Machine, Rotary Surface Grinding Machine.
ORTLIEB Drill Grinding Machine, Tap and Die Grinding Machine.
U.V.A. Internal Grinding Machine.
WEBSTER & BENNETT Boring and Turning Mill.

WICKMAN *of*

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152 NATIONAL HALL GALLERY

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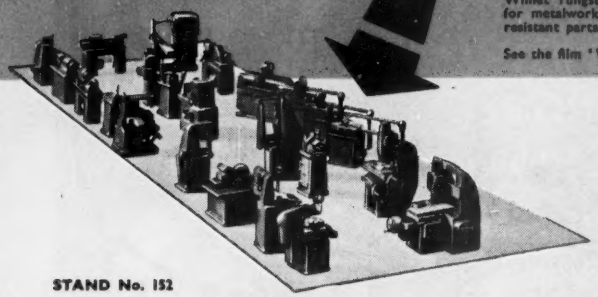
STAND No. 227

Wimet Tungsten Carbide Tipped Tools for metalworking industries, and wear-resistant parts.

See the film 'Wimet at Work' in the cinema on **STAND No. 264.**



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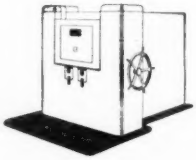

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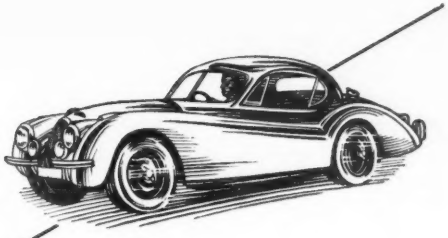

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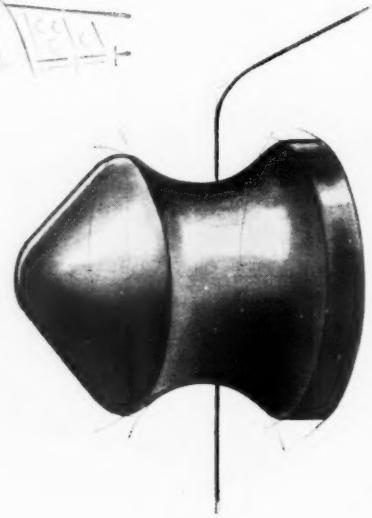

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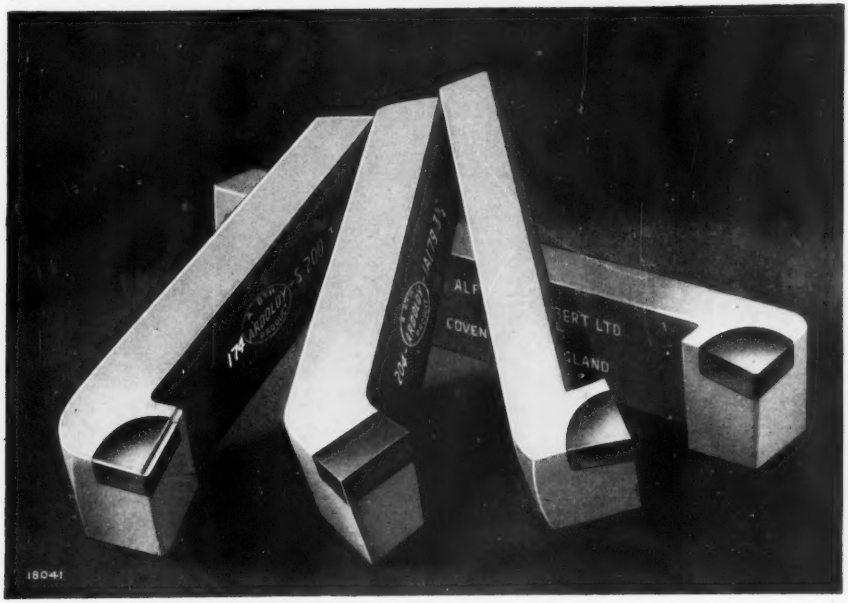

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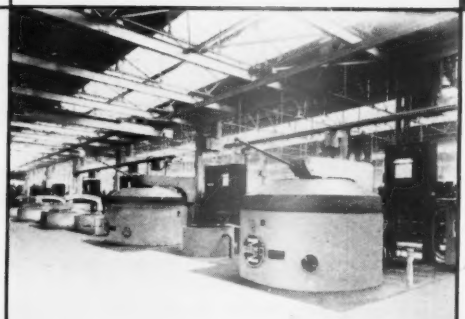

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65 kW.	2′ 0″	3′ 6″
85 kW.	2′ 3″	4′ 6″
150 kW.	3′ 0″	4′ 6″
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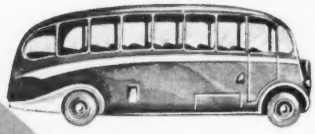

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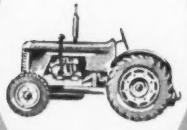

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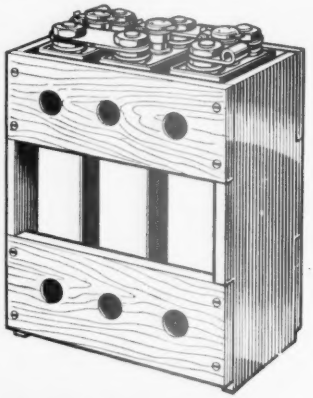

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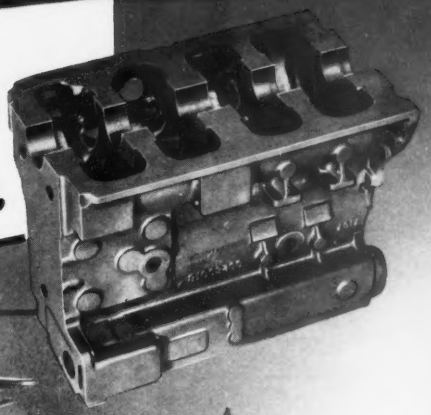

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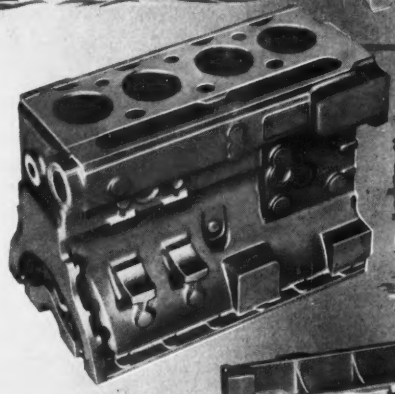

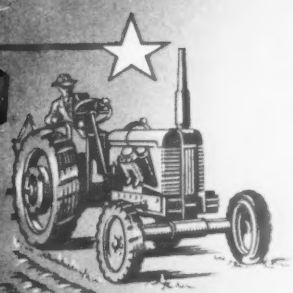

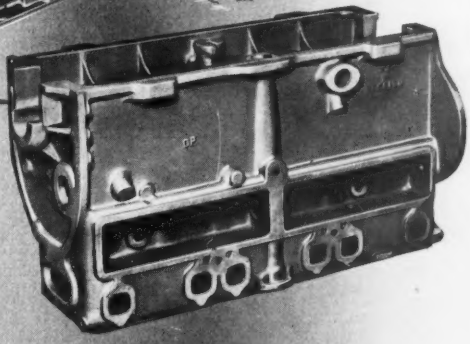

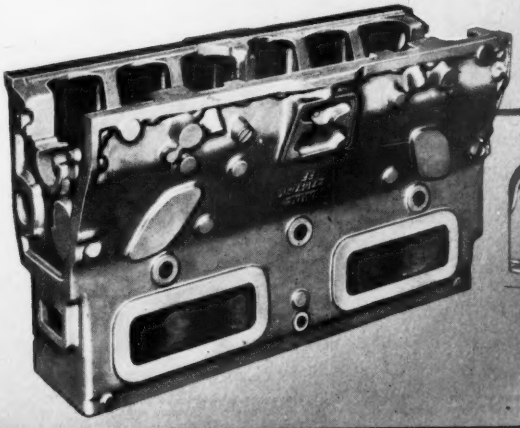

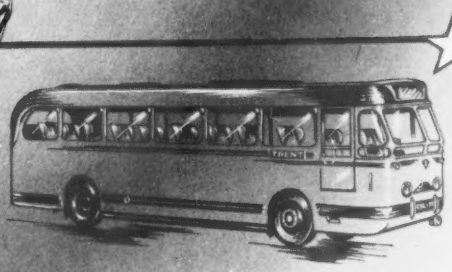

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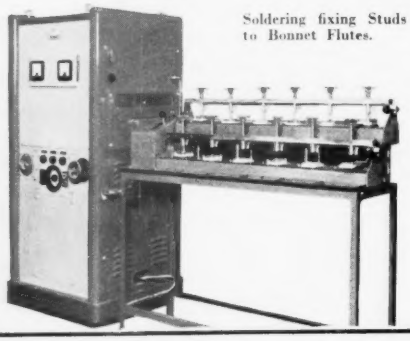

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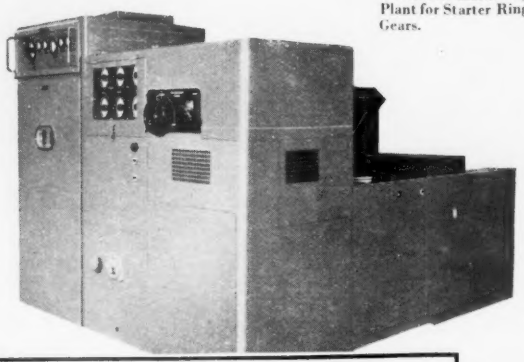

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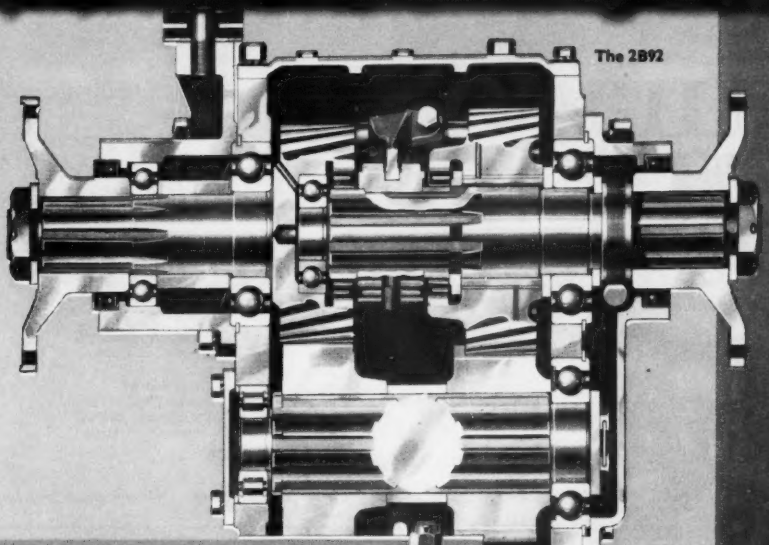

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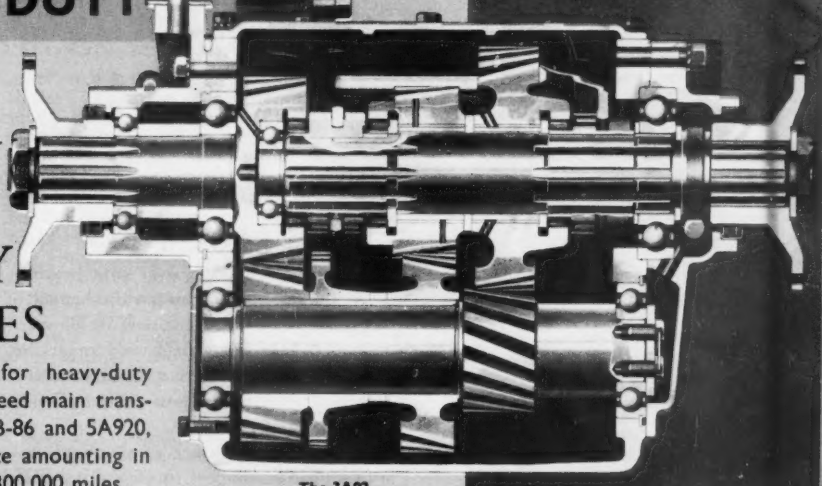

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These boxes have helical gears mounted on long bushings, all changes being made by jaw-type clutches.

Gear ratios :

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	Weight	350 lb.
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2B92 —	Direct	1:1
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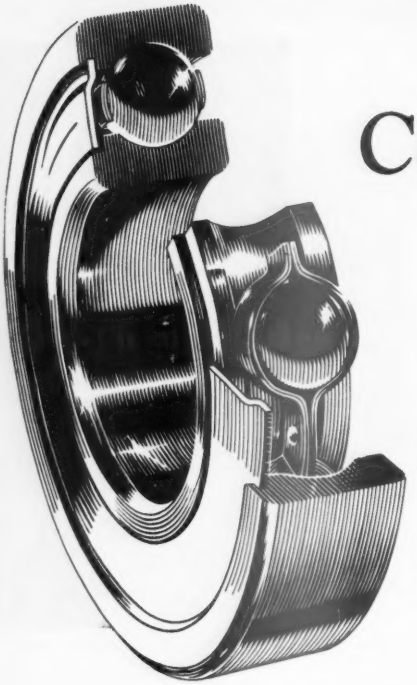

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Co-operative Research

RESEARCH on some subjects is best carried out by individual organizations; for others co-operative research is the more practical. There are many different opinions about where the dividing line should be drawn. Where there is a reasonable doubt, we think that individual research should be given the preference. It almost certainly entails some duplication of effort, but against that can be set the added urgency engendered by the desire to forestall other organizations that may be investigating the same problems.

Competition is still a vital factor in progress, and only the most compelling reasons warrant any action that will diminish the competitive spirit. Nor must it be forgotten that in industrial research time is very important. Any one familiar with the work of research teams will know of the tendency to seek perfection, regardless of time. This attitude must be combatted, particularly in co-operative research.

Nevertheless, there are investigations in which the case for co-operative research is immeasurably the stronger. If the investigations are to be carried out thoroughly—nothing less will do—and brought to a useful conclusion in a reasonable time the financial commitments may be far too great for other than the very largest organizations.

In research work, the quality of the team leader is of primary importance. Therefore, it must be asked whether there are sufficient men of the required calibre and with the necessary knowledge to act as team leaders if several parallel researches are being pursued concurrently. Even if there are, is there justification for having them working on the same problems?

Gas turbines

So far as the automobile industry is concerned, the further development of gas turbines for road vehicles is an extremely suitable subject for co-operative research. What has already been accomplished by The Rover Co. Ltd. is beyond praise, but much remains to be done before a car with a gas turbine power unit can be produced commercially. There is a possibility that in the not-too-distant future a number of special sports cars may have these power units, but there is no available evidence to suggest that they will be suitable for passenger car work for some long time to come.

Yet, if the British automobile industry is to retain the lead in this field, there is the most urgent need for intensified research. We have all seen what jet developments, the de Havilland Comet for example, have done for the British aircraft industry; now we should like to see the British automobile industry indisputably lead the field in the development of gas turbines for road vehicles. The technological knowledge is available, but has any one organization the resources that will allow it to be used to the full?

The argument for co-operative research is unanswerable. There are many problems to be solved. Many of them are closely inter-related and yet at the same time they are sufficiently independent not to necessitate their all being carried out at one centre. The full resources of the automobile industry should be mustered, and supplemented by those of the appropriate existing co-operative research associations. Specific problems could then be entrusted to the organization, or organizations, most likely to solve them quickly. Co-ordination of the various researches, an essential function, could be the responsibility of a body such as The Department of Scientific and Industrial Research. A policy of this character seems to offer the greatest chance of success in the shortest possible time.

Government encouragement

If the automobile industry showed a determination to act as a unit in gas turbine research, with a complete disregard of prestige for individual companies, there would be a very strong case for Government assistance, both through direct financial grants and through a definite assurance that as soon as a suitable unit had been developed orders would be placed for military vehicles with gas turbine power units.

Direct financial assistance would not appeal to the automobile industry because of the fear that it might lead to more official control. This objection would be removed if the precedent of grants to Universities were followed. That is, the sum to be granted would be defined by the Government, but the use to which it was to be put would remain at the absolute discretion of the industry.

An assurance that definite orders would be placed for military vehicles with gas turbine engines would be a great encouragement for all concerned. The primary problems must be solved by designers and metallurgists working in close co-operation, but whether the results of their labours can be applied commercially will rest with the production engineers. They also will have to solve many problems

differing in kind from those that have hitherto confronted the automobile industry. An assured market for a reasonable number of engines would be the best incentive for the development of the novel production techniques that will have to be evolved before gas turbines for road vehicles can be produced economically.

Information Services

THERE is an increasing tendency for both design and production engineers in the automobile and ancillary industries to specialize more and more narrowly. At the same time, the rate of advance in technical developments is being accelerated, and it is now difficult for an engineer to be cognisant of, much less to be conversant with, advances in his own specialized sphere. It is even more difficult for an engineer to keep abreast of developments that lie outside, but yet may influence, his work.

There is only one way that a company can ensure that its staff keeps in contact with technical developments, that is, the effective dissemination of technical information from many different sources. Obviously, the first essential is that the information should be readily available. In some degree this aspect has been dealt with in a fairly satisfactory manner by the automobile industry. For example, the "Big Six" all have large technical libraries, and most of the smaller companies are equipped in relation to their resources. Incidentally, a small library is not necessarily a serious handicap, since nearly every factory of any size in this country is within reasonable reach of excellent public library facilities.

Library organization

More important than mere size, is the scientific indexing of the reports, articles and books that are stored in the library. For example, a designer wanting information on cam design should be able to get a list of the most recent works on the subject, from which to select those relevant to the particular points he wishes to study.

Unfortunately, the titles of papers do not always give an accurate indication of the scope of the work covered. For this reason it is important to include, either in the index or in a separate file, a brief abstract of every paper. The M.I.R.A. abstracts are good examples of this type of information service. However it is doubtful whether all companies make the best use of them. It is not sufficient merely to have copies in the library; they must also be brought to the attention of all they conern.

One of the most important functions of an information department is that of keeping the Company's specialists appraised of the latest published developments on their subjects. Individual engineers cannot even expect to read all the published matter coming within their field. Unfortunately, the time spent by engineers in searching for sources of information is seldom, if ever, charged as a library cost. If it were, it would make clear that an apparently expensive librarian can be an economy.

Too often foreign reports are completely neglected because of language difficulties. Admittedly, a large proportion of published technical information comes from America, and with this there is no language difficulty. But the problems of European manufacturers, particularly those of Germany, France and Italy, are more akin to our own, and it is folly to ignore Continental developments. Here again an efficient abstracting service could be of very great value.

Centralized abstracting

For every organization to have its own abstracting service would be a waste of time, money and effort. Nor would many of them be likely to be efficient. It would be both more economic and efficient if the automobile and ancillary industries organized a central abstracting service. The cost to any one company would be relatively small, if the service were properly organized. Only a small central secretariat would be necessary, since it should be possible to have a large panel of abstractors working on a part-time basis and paid only for actual work done. Such a system was worked successfully by The Institution of Civil Engineers. At a very moderate cost, such a scheme would allow engineers in the industry to be appraised of all published technical developments.

In many ways, the information published in technical journals and the Proceedings of the various technical institutions is much more important to the engineer than the information in standard text-books. Reference works and standard text-books are essential tools for the engineer, but they can never include current developments. In fact, many technical works are, of necessity, slightly out-of-date when they are published. An efficient abstracting service, covering technical journals and institution Proceedings can be an invaluable aid to both design and production efficiency.

CONTENTS

Page

Editorials 323-324
Co-operative Research. Information Services

The Vauxhall Square Engines 325-332
Two Models with Many Common Components

German Commercial Vehicles. By K. B. Hopfinger 333-337
A Review of Design Trends

S.G. Cast Irons 338-340
Notes on the Properties and Uses of an Important Material

Synthetic Resins 340
Some Materials for Use in Foundries

Machine Tools 341-358
Pre-view of the Forthcoming International Machine Tool Exhibition

Nimonic 95 358
An Improved Nickel-Chromium Alloy for Gas Turbine Components

The R.P. Lubricator. By D. A. Sams 359-363
A Range of Units for Automatic Lubrication of Chassis Components

Recent Publications 363-364
Brief Reviews of Current Technical Books

Ethylene Glycol. By J. L. Koffman 365-367
Its Use as an Engine Coolant in Cold Temperatures

Current Patents 368
A Comprehensive Review of Recent Automobile Specifications

THE VAUXHALL SQUARE ENGINES

Two Models with Many Common Components

WHEN restrictions on design, imposed by the horse power tax, were removed in 1947, Vauxhall Motors Ltd., of Luton, initiated work on two new engines for their passenger cars. These have now been thoroughly tested and are in full production. The 1½ litre unit for the Wyvern, EIX, has four cylinders and the 2¼ litre engine for the Velox, EIP, has six, but both have the same bore and stroke. Because of this, many of the components are common to both engines.

The advantages claimed for the square design are well known. With the greater bore, larger valves and ports may be incorporated, and better breathing is obtained. Piston speed is less, and the mechanical losses due to piston friction are correspondingly reduced. These improvements in efficiency naturally result in improved fuel consumption; in fact, in terms of miles per gallon, savings of as much as 10 per cent in the six cylinder engine and 6 per cent in the four have been effected. Moreover, because of the lower piston speed, the life of the engine before a re-bore becomes necessary is proportionally increased. This no doubt will be particularly noticeable in the new Velox engine, in which the piston travel per mile is 31 per cent less than in the old one. In the new Wyvern unit, the improvement is 24·5 per cent. As a result of the short stroke, the axes of the big end and main journal bearings are not so widely separated, so that the rigidity of the crankshaft is much improved in both models.

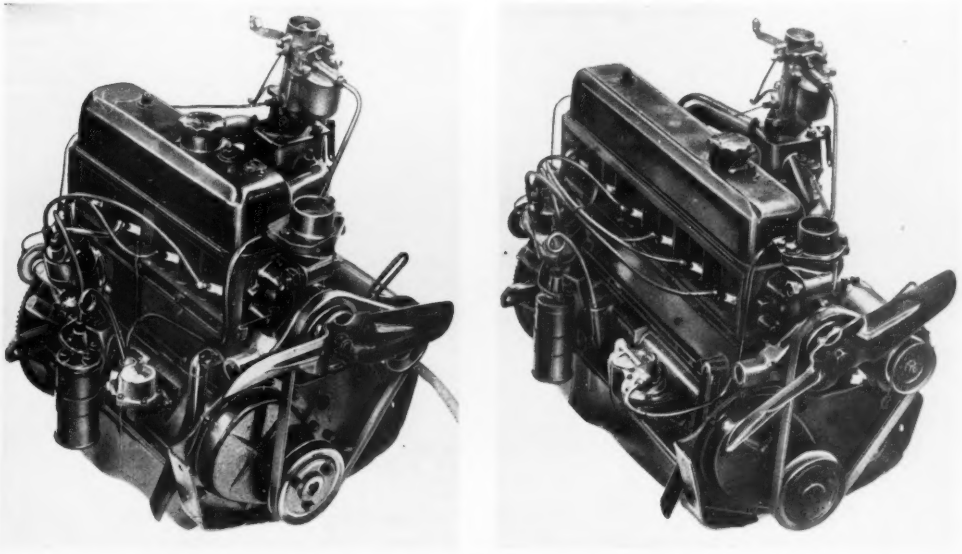
SPECIFICATION

WYVERN ENGINE: Four cylinders. Bore and stroke 3⅛ in × 3 in. Swept volume 92 in³ (1,507 cm³). Maximum b.h.p. 40 at 4,000 r.p.m. Maximum b.m.e.p. and torque 116 lb/in² and 71 lb-ft at 2,000 r.p.m. Compression ratio 6·4:1. Three-bearing, counter-balanced, forged crankshaft. Push-rod operated overhead valves. Carburettor: Zenith 30 VIG 7, 25 mm choke.

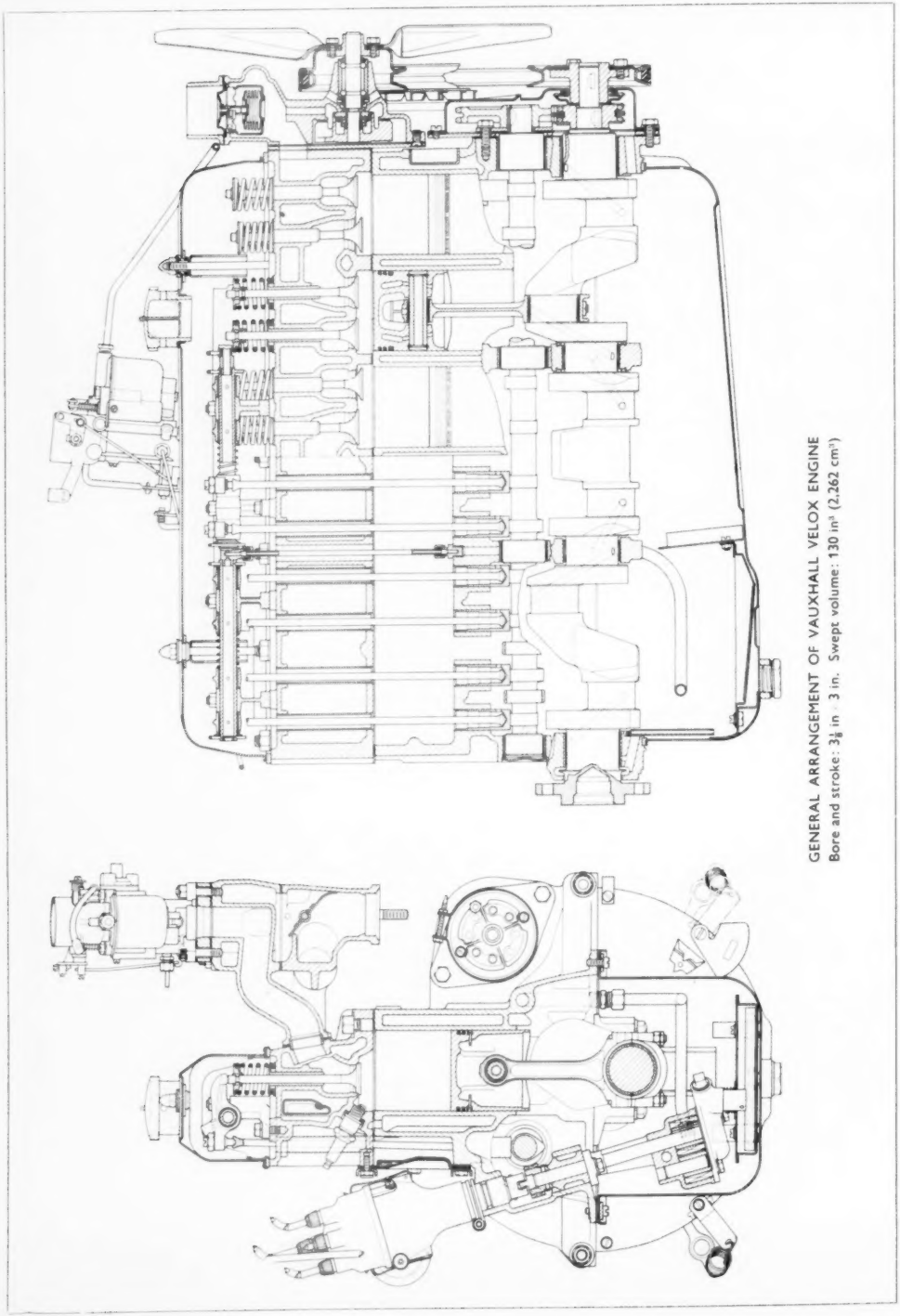
VELOX ENGINE: Six cylinders. Bore and stroke 3⅛ in × 3 in. Swept volume 138 in³ (2,262 cm³). Maximum b.h.p. 64 at 4,000 r.p.m. Maximum b.m.e.p. and torque 120 lb/in² and 108 lb-ft at 1,200 r.p.m. Compression ratio 6·4:1. Four-bearing, counter-balanced, forged crankshaft. Push-rod operated overhead valves. Carburettor: Zenith 30 VIG 7, 27 mm choke.

The torque curve for the Wyvern is flatter than the old one, a characteristic that indicates better top gear performance. The rapid rise at the beginning of the Velox torque curve is probably due to induction pipe resonance. Because of the better breathing characteristics, the b.h.p. curve rises to 4,000 r.p.m. as compared with 3,500 r.p.m. on the older unit. The increase of maximum b.h.p. is out of all proportion to the increase in capacity. This is due, chiefly, to better mechanical and volumetric efficiency. The capacity of the new Velox engine is a fraction smaller than its predecessor, 138 cu in compared with 138·8 cu in. In spite of this, the new unit gives 64 b.h.p. as compared with 58·3 b.h.p. on the older one. In other respects, the remarks already made concerning the Wyvern engine apply, in general, to the larger model.

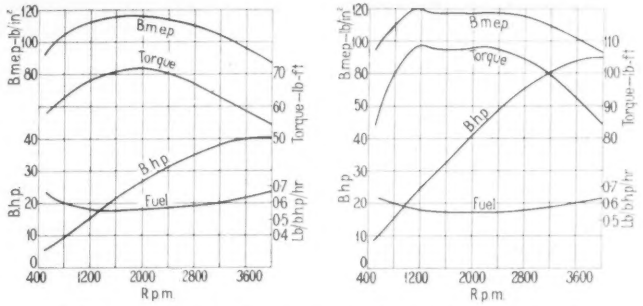
The engine is not absolutely square: the bore stroke ratio is slightly more than 1·04:1, and a connecting rod length stroke ratio of 1·79:1 has been adopted. This arrangement gives the low mean piston speed of 2,000 ft min at 4,000 r.p.m. The maximum b.m.e.p. of the Wyvern is 116 lb in² at 2,000 r.p.m. and that of the Velox is 120 lb in² at 1,200 r.p.m. In terms of b.h.p. per square inch of piston area, the six-cylinder engine is better than the four, the figures being respectively 1·39 and 1·3.



To economize in material, the right-hand sides of the cylinder heads of both four- and six-cylinder models are recessed



GENERAL ARRANGEMENT OF VAUXHALL VELOX ENGINE
Bore and stroke: 3⅛ in. × 3 in. Swept volume: 130 in³ (2,262 cm³)



Auxiliary equipment fitted : air cleaner, generator (not charging), and water pump but no fan Ignition : adjusted for maximum power. Exhaust : shop system.

Engine performance curves. Wyvern, left. Velox, right

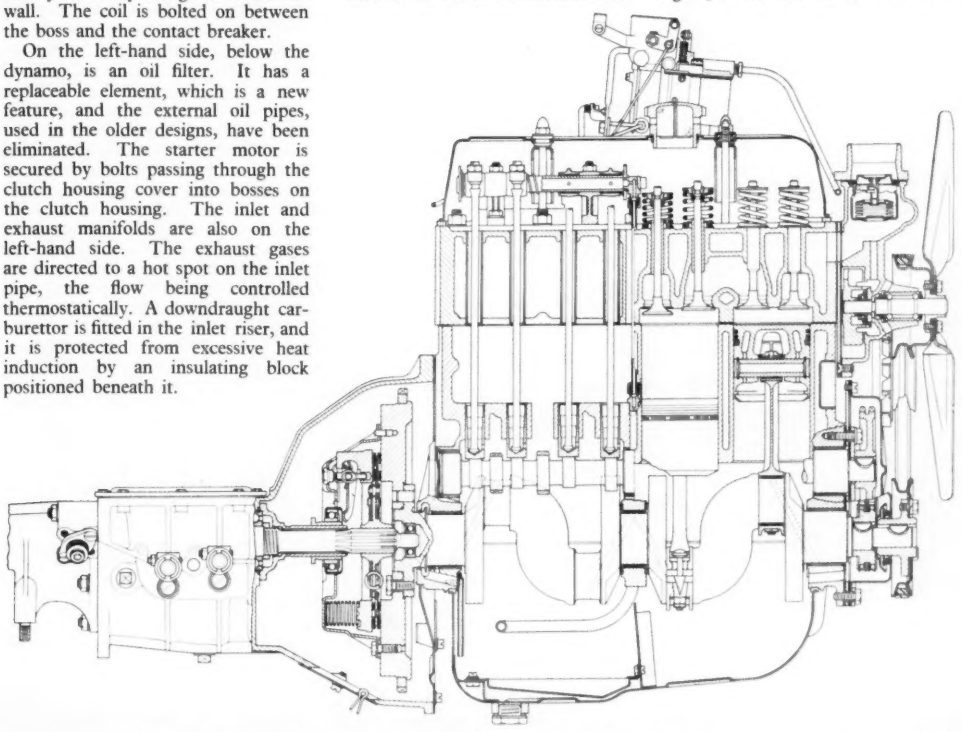
So far as general arrangement is concerned, both engines are similar. At the front, there is a triangulated V-belt drive for the dynamo, and fan and water pump. The thermostat housing is integral with the water pump bolted to the front of the head. On the right-hand side, at the front, bolted to the tappet cover is the engine breather pipe; it extends to a level about $1\frac{1}{2}$ in below the sump face joint. Behind this, on the crankcase wall is the fuel pump. At the extreme rear, an adaptor for the windscreen wiper drive is bolted on the side wall of the crankcase adjacent to the camshaft, and immediately in front of the adaptor is a boss for the ignition contact breaker and distributor unit. The dipstick is carried in a boss approximately half way along the crankcase wall. The coil is bolted on between the boss and the contact breaker.

On the left-hand side, below the dynamo, is an oil filter. It has a replaceable element, which is a new feature, and the external oil pipes, used in the older designs, have been eliminated. The starter motor is secured by bolts passing through the clutch housing cover into bosses on the clutch housing. The inlet and exhaust manifolds are also on the left-hand side. The exhaust gases are directed to a hot spot on the inlet pipe, the flow being controlled thermostatically. A downdraught carburettor is fitted in the inlet riser, and it is protected from excessive heat induction by an insulating block positioned beneath it.

Cylinder block and crankcase

An integral cylinder block and crankcase of Chromidium cast iron is employed for both engines. Between each pair of cylinders the water jacket space is a minimum of $\frac{1}{4}$ in, while at the front and rear ends, it is $\frac{1}{2}$ in. This arrangement obviates any danger of hot spots and distortion that sometimes occur with siamesed cylinders. Full length water jackets are incorporated.

At the rear there is a machined face to which the integral clutch and gearbox housing, with its cover plate, is secured by four cold drawn, 25-ton, carbon steel bolts. The bottom pair, one on each side, are in reamed holes 0·454 in diameter to locate the unit, while the top pair are $\frac{7}{16}$ in diameter set bolts screwed into the cylinder block. At the front, a pressed steel timing cover is bolted on, together with the $\frac{5}{32}$ in thick front engine plate and a paper joint washer. On each side of this plate, flanges are turned forward to carry the engine mounting. The crankcase wall extends down to a level of $\frac{1}{8}$ in below the axis of the crankshaft, and for lateral location, the main journal bearing caps are recessed $\frac{1}{8}$ in into the lower face of the webs in which they are carried. In the four cylinder engine, there are three webs each



General arrangement of Vauxhall Wyvern engine. Cylinder dimensions are the same as for the Velox, giving a swept volume of 92 in³ (1,507 cm³)

carrying a main journal bearing, while in the six cylinder there are four. The bearing caps are secured by $\frac{7}{16}$ in diameter manganese molybdenum steel bolts, locked by spring washers. The sump oil seal is formed, both at the front and at the rear, by a sealing strip in a groove around each cap. This strip, $\frac{3}{16}$ in thick, is of synthetic rubber and cork, and on it seats a lip, turned out around a semi-circular cut-out on the pressed steel sump. The bolts securing these two end bearing caps are outside the sump. Around the front of No. 1 bearing cap is a flange tapped for one $\frac{5}{16}$ in diameter set bolt for pulling it up against the engine plate to form the oil seal. Thus, the bridge pieces commonly used to complete the oil seal below these two bearings, are eliminated.

Crankshaft, connecting rods and pistons

In both engines, the forged crankshaft is made of En8D. All main journals are $2\frac{1}{8}$ in diameter. The front bearings are 1·5 in long, those at the rear are 1·25 in long, while the length of the intermediate bearings, in both models, is 0·845 in. With this arrangement, only three different main journal bearing shells are needed. The main bearing clearances are all 0·0008 in to 0·0027 in, except in the four cylinder engine, where the centre one is 0·0008 in to 0·0022 in. Crankshaft end float is 0·002 in to 0·012 in. The crank pins in both the Velox and the Wyvern are 1·873 in diameter and the bearing shells are $\frac{7}{8}$ in long. A conventional arrangement of counterbalance weights has been adopted. In the small engine, one weight is integral with each web adjacent to the journal bearings, while in the larger unit, the balance weight between Nos. 3 and 4 crank pins is counter balanced by two more, one adjacent to the front journal bearing, and the other adjacent to the rear one.

Machined integrally with the crankshaft, at the rear, is an oil thrower ring working in a space drained to the sump by two passages that are drilled through the rear journal bearing cap. At this end of the crankshaft there is no other oil return or seal. Bleed holes are drilled, from a point near the rear end of the bearing, into each of the two passages. These bleed holes remove most of the surplus lubricating oil before it reaches the extreme rear. Thus, they prevent the flooding of the drainage space round the oil thrower, and eliminate any possibility of oil leakage into the clutch housing. Under certain conditions, with the crank web continually rotating past the lower end of the two passages, a build-up of pressure could prevent the oil from draining away. To obviate this, a baffle tube is fitted to carry the oil directly down to the sump. The tube, of approximately rectangular cross section, is built up of a flat back plate to which is spot-welded a pressed steel channel section, flattened at the top end. It is secured to the front face of the bearing cap by two $\frac{1}{4}$ in diameter self-tapping screws.

To the rear of the oil return scroll there is a flange to which the high tensile cast iron flywheel, common to both engines, is secured by five $\frac{3}{8}$ in diameter bolts, positive location being effected by two $\frac{7}{16}$ in diameter dowels. A separate ring gear, with 122 teeth, is shrunk on. The tail end of the crankshaft is counter-bored $1\frac{3}{8}$ in diameter for a ball bearing that carries the front end of the clutch shaft.

Stamped H-section connecting rods, made of manganese steel, are employed. They have a centre-to-centre length of $5\frac{3}{8}$ in. Each of the big end bearing caps is secured by two $\frac{5}{16}$ in diameter En111A or En16B special bolts. The greatest overall width is only $2\frac{1}{8}$ in so that, in spite of the fact that the bearing is split at right angles to the axis of the connecting rod, it may still be withdrawn through the cylinder bore. The diametral clearance of the big end bearing is 0·0005 in to 0·0025 in, and the end float is 0·006 in to 0·012 in. A Vandervell L.2785 bush, $\frac{7}{8}$ in long, is pressed into the small end, the diametral clearance between it and the En202, hollow gudgeon pin being zero to 0·0006 in. The outside and inside diameters of the gudgeon pin are $\frac{3}{4}$ in and $\frac{3}{8}$ in respectively, and its bearing surface is case hardened, ground and lapped. End location is by means of circlips in the piston bosses which have an effective bearing length of $\frac{13}{16}$ in. Vertically drilled holes in the bosses assist splash lubrication.

The flat-topped pistons, made of LM.14WP or LM.15WP aluminium alloy, are tin plated to facilitate running in. Their skirts are T-slotted and oval-ground. Three rings are fitted above the gudgeon pin. The top one is a straight flanked compression ring; the second, a cornered compression ring; and the bottom one, a slotted oil control ring. A cornered compression ring is, of course, one which, in its cross section, has a rectangular portion machined from its upper face adjacent to the inner corner. This weakens the upper part of the ring so that the lower part bears with greater force on the cylinder bore to give an effect, similar to that of a tapered ring. This assists running-in.

PISTON RING DATA

	Top Ring	Centre Ring	Oil control ring
Width	0·094 in	0·094 in	0·187 in
Side clearance	0·0015 to 0·00325 in	0·0010 to 0·00275 in	0·0010 to 0·00275 in
Ring gap in bore	0·007 in 0·021 in	0·007 to 0·021 in	0·007 to 0·021 in

CAMSHAFT DATA

	Wyvern	Velox
Bearing diameters,		
Front	1·7885 in	1·8193 in
Front intermediate	—	1·7885 in
Centre	1·7573 in	—
Rear interchangeable	—	1·7573 in
Rear	1·726 in	
Bearing clearance	0·0025 to 0·004 in	
Bearing lengths,		
Front	1·28 in	
Front intermediate	—	0·81 in
Centre	0·81 in	—
Rear intermediate	—	0·81 in
Rear	0·81 in	
End float	0·002 to 0·004 in	

Camshaft and valve gear

A duplex roller chain of $\frac{3}{8}$ in pitch, is employed to drive the camshaft. There is no provision for fine adjustment of the timing, or for tensioning the chain. The driving sprocket, made of 50-ton carbon steel, is keyed on to a 1 in diameter forward extension of the crankshaft. Its rear face bears against a $1\frac{3}{8}$ in shoulder on the shaft. Clamped between the front face of the sprocket and the mild steel boss of the fan belt pulley, is a pressed steel oil thrower. A felt oil seal bears round the pulley boss which is keyed onto a $\frac{13}{16}$ in diameter extension of the crankshaft.

The seal is housed in an annulus formed by a flanged ring, pressed and spot welded into a dished recess in the timing cover. To prevent oil from running down inside the front wall on to the oil seal and pulley boss, a flanged ring is pressed on to the outer periphery of the dished oil seal housing. The oil thrower is of such a shape as to completely enshroud the seal housing assembly.

The two-piece, fabricated fan-belt pulley is secured to the flange round the boss by three $\frac{5}{16}$ in diameter set bolts with spring washers. There is no provision on the passenger car engines for a starter handle, and the pulley boss, like the drive sprocket, is pressed and keyed on to the front extension of the crankshaft. There is no further provision for axially locating these wheels.

This is an unusual arrangement in engines designed in this country, although it has been standard Vauxhall practice for many years.

A $\frac{7}{8}$ in diameter forward extension of the camshaft carries the cast iron half-speed wheel which is pressed and keyed on. Axial location of the camshaft is effected by a leaded phosphor bronze, sand cast plate that registers between the boss of the half speed wheel, and the shoulder formed by the front camshaft bearing. This plate is secured by two $\frac{5}{16}$ in diameter set bolts, with spring washers, passing through the front plate and screwed into the front wall of the crankcase. The half speed wheel is only pressed on, but this method of end location is satisfactory, because the normal thrust from the oil pump and distributor drive gear is in a rearward direction.

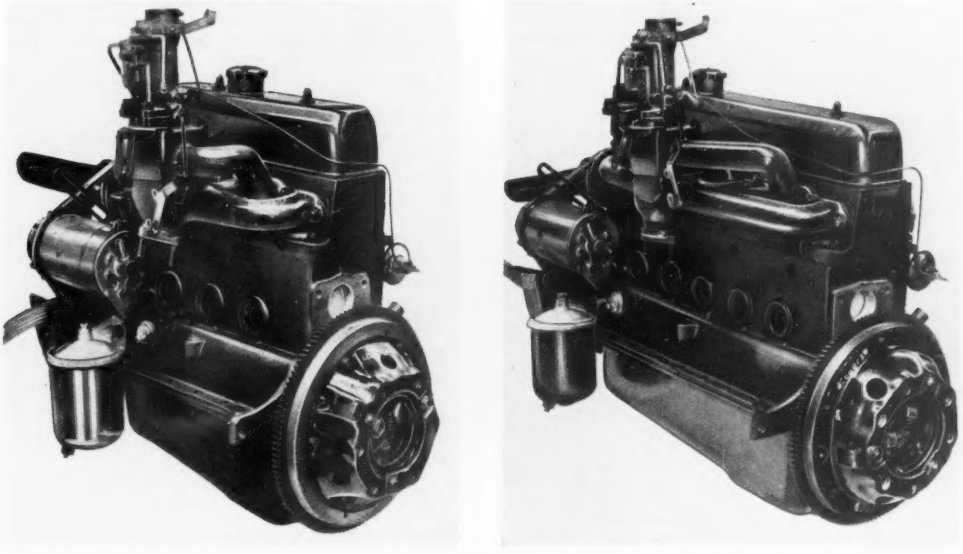
VALVE DATA

	Inlet	Exhaust
Head diameter	1·375 in	1·25 in
Throat diameter	1·094 in	1·031 in
Stem diameter	0·311 in	0·310 in
Seat angle	29 deg	44 deg
Nominal lift	0·336 in	0·336 in
Valve clearance	0·013 in	0·013 in
Valve stem and guide clearance	0·001 to 0·00275 in	0·0015 to 0·00375 in
Valve opens	13 deg B.T.D.C.	45 deg B.B.D.C.
Valve closes	39 deg B.B.D.C.	7 deg A.T.D.C.
Spring rate	250 lb/in	250 lb/in
Spring length, free	1·663 in	1·663 in
Spring length, fitted	1·50 in	1·50 in
Spring outside diameter	1·25 in	1·25 in

Two spiral gears are machined on the camshaft between the rear two bearings. The front gear drives the oil pump and contact breaker and distributor unit, while the rear one is for the windscreen wipers. An eccentric to operate the fuel pump is situated between the two front bearings. Steel-backed, tin-based babbit shell bushes are pressed into the bosses for the three camshaft bearings on the four cylinder engine, and for the four bearings on the larger engine. The cams are specially designed for efficient operation. They incorporate ramps to take up the tappet clearance quietly.

Piston-type tappets, made of chilled cast iron, are employed. Oil drain holes are drilled near the base. The effective length of the EN8B push rods is about $10\frac{3}{4}$ in; their diameter is $\frac{9}{32}$ in. The ball ends that seat in the tappets as well as the cup ends at the top, are up-set. Ball-ended tappet adjustment screws made of En32A are fitted in the ends of the EN8C rockers. They are secured with locknuts. Rolled brass bushes are pressed into the bores of the rockers, and the end pads that bear on the valve stems are milled and ground before hardening. They are lapped after water quenching.

On the four cylinder engine, the rocker shaft, of $\frac{11}{16}$ in outside diameter by $\frac{7}{16}$ in inside diameter high carbon steel tube, is in two pieces, while in the six cylinder unit it is in three. Between the two parts, on the four cylinder engine, there is a brass junction piece, on the lower face of which is fitted a union for the lubricating oil supply. Cylindrical bosses, one on the front and one on the rear



Left-hand sides of the four and six cylinder engines. At the rear, only four bolts secure the clutch and gearbox housing

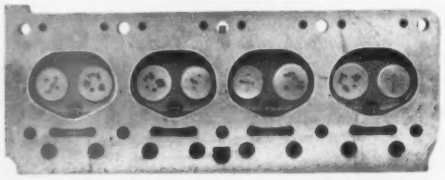
face of the junction piece, are carried in the adjacent hollow ends of the rocker shafts. In the six cylinder engine, the junction piece is between Nos. 4 and 5 cylinders. The other break in the shaft, between Nos. 2 and 3 cylinders, is fitted with a similarly shaped piece, but has no provision for a union for the lubricating oil supply.

Each portion of the rocker shaft is supported, on both engines, by two pedestals. Between the rockers there are compression springs round the shaft, to constrain them against the pedestals. Constraint for the end rockers is furnished by conical coil springs bearing against spring clips registering in grooves round the ends of the shafts. Each pedestal is secured on one side by a $\frac{5}{16}$ in diameter set bolt passing through a lug at the foot, and on the other side by a $\frac{5}{16}$ in diameter stud. Both are screwed into the cylinder head. The pedestals are split on the side where the studs pass through, so that when the nuts are tightened, they clamp the shaft. In addition, to give more positive location, the studs register in a recess machined on the periphery of the shaft.

A single valve spring is employed with each valve. It bears, at its top end, against a washer that is retained by split tapered collets. At its lower end, it is located on a pressed steel washer around the valve guide. A rubber ring in an annular groove on the inlet valve stem below the lower end of the collets effectively prevents an undue amount of oil from running down the guide. There is, of course, no such ring around the exhaust valve stems. The cast iron valve guides are $2\frac{3}{16}$ in long by $\frac{13}{32}$ in outside diameter. All guides are interchangeable.

Cylinder head and manifolds

The outstanding feature of the design of the chromium-alloy iron cylinder head casting is the way in which material and weight have been saved. At the cylinder head joint, where a copper and asbestos gasket is fitted, the overall width is $6\frac{1}{16}$ in, while the top face is only $4\frac{1}{2}$ in wide. The overall depth is $4\frac{1}{16}$ in. On a plane about mid-way between the top and bottom faces the overall width is, for the most part, about $3\frac{3}{8}$ in.



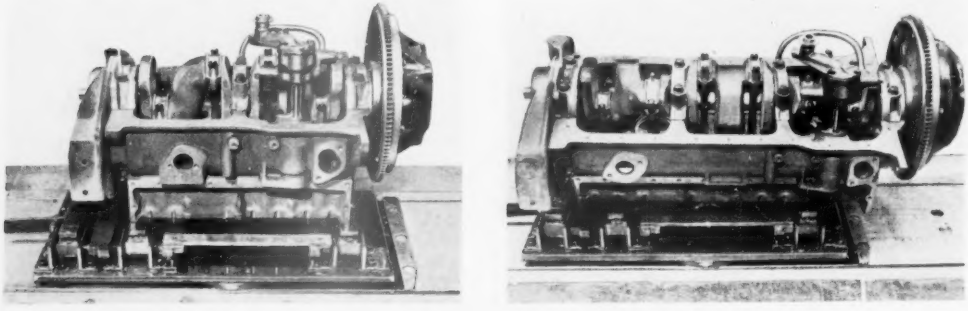
Water passing from the cylinder head to the block completely encircles the spark plug bosses

This dimensional economy has been effected by recessing almost all the face that incorporates the spark plug bosses. Only the front and rear walls, and some vertical bosses extending between the upper and lower walls of the recess, extend to the full width. In the six cylinder engine, there are two of these bosses positioned between Nos. 2 and 3 cylinders and between Nos. 4 and 5 cylinders; while in the smaller engine there is only one, which is centrally positioned. The bosses are cored $\frac{3}{8}$ in diameter to act as an oil return from the rocker chamber, and a pressure oil pipe, feeding the rocker gear, passes up through the appropriate boss.

Where it passes through the head, each of the push rods is housed in a $\frac{3}{4}$ in diameter tube pressed into two bosses, one in the upper and the other in the lower walls of the recess Ten holding-down studs are employed in the four cylinder engine, and fourteen are fitted in the other, all are $\frac{7}{16}$ in diameter. On the right, they pass through the head but, on the left-hand side, they are shorter and pass through a flange about $\frac{13}{16}$ in thick by $1\frac{1}{8}$ in wide. From this flange, the side of the head tapers inwards towards the top face. This arrangement is possible because the axes of the valves are positioned in one longitudinal plane, off-set $\frac{7}{32}$ in to the right-hand side of the cylinder axes. It gives a comparatively short length to both the inlet and exhaust ports in the head while, at the same time, the water jacketing is ample. Efficient cooling of the exhaust valve seats and spark plug bosses is ensured by the incorporation of a distributor pipe in the jacket, on the right-hand side of the head. The pipe has holes punched in it to direct the water round these components.

The pressed steel rocker cover is reinforced locally at two points by channel sections, positioned transversely inside it. These provide support where the two domed nuts pull the cover down on the $\frac{5}{16}$ in diameter studs screwed into the cylinder head. Under each nut is a plain washer that bears on a grommet in a hole in the cover which is reinforced by a welded-on steel washer. This construction, together with the $\frac{3}{16}$ in thick linen reinforced, granulated cork joint washer on the head, damps out resonant vibrations.

Overhanging the push rod chamber, the right-hand face of the head forms part of the joint to which the push rod cover is secured by $\frac{1}{4}$ in diameter set bolts. The bolt heads seat in 16 S.W.G. channels that extend the



The holding-down bolts for the end bearing caps are outside the sump

length of the head at the top and the length of the block at the bottom. Two dished pressings form the cover. They fit one inside the other, with a block of felt interposed between them to damp out resonance.

Siamesed inlet, and separate exhaust ports are incorporated. The branch pipes of both the manifolds are flanged, and attached by $\frac{5}{16}$ in diammeter studs to the head. A long, steel-reinforced, asbestos joint washer is fitted, with the steel face against the cylinder head, both to the exhaust ports and to the sleeved inlets. These sleeves provide positive location at the junction between the head and the manifold.

Under normal running conditions, a thermostatically controlled butterfly valve closes a port in the top of the cast iron exhaust manifold, but when the engine is cold this valve is open and directs exhaust gas on to a local hot spot, round the junction of the cast iron inlet manifold branches with the integral riser pipe and back into the exhaust. The two manifolds are held together by four $\frac{5}{16}$ in diameter studs and nuts locked with spring washers, the joint being sealed by a steel washer. Round the inner periphery of the washer a lip is turned back through 180 deg to form a resilient seal. To localize the heating effect, a block of moulded asbestos composition is interposed between the carburettor and the riser pipe.

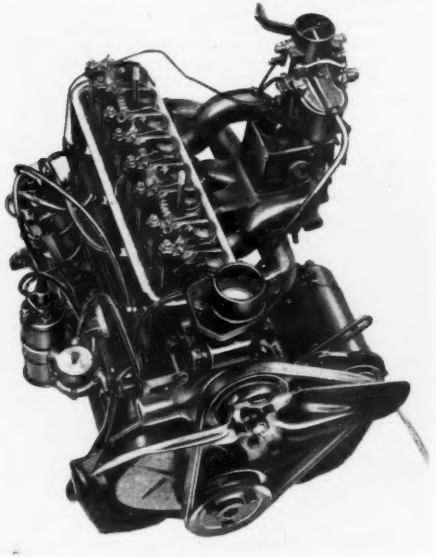
The carburettor is supplied with fuel from an A.C. mechanical pump with, in the four cylinder engine, a gauze filter above the pump, and in the six cylinder engine, a similar filter in a glass sediment bowl to the rear of it. A Zenith 30 VIG-7 carburettor is mounted on the manifold with the float chamber towards the front. In the Wyvern a 24 mm choke is used, while that in the Velox is 27 mm diameter. The throttle and choke controls are interconnected for easy starting, the choke flap being eccentrically hinged and spring-loaded so that it opens to prevent an over-rich mixture as the engine picks up. An accelerator pump and a part-throttle economy device are incorporated. Induction pipe noise is reduced by fitting an A.C. air filter and silencer.

Water pump and coolant system

A one-piece, cast iron housing, bolted to the cylinder head, carries the thermostat and water pump. It is closed at its rear end by a $\frac{5}{16}$ in thick mild steel plate. The thermostat is housed in the upper part of the casting, the by-pass being a duct drilled vertically between the outlet and the inlet. Axial location of the rotor and spindle assembly is effected solely by the interference fit, in a forward extension of the casting, of the tubular housing for the two-row, sealed ball bearing. The centres of the balls are spaced $1\frac{1}{16}$ in apart, and their races are formed by annular grooves round the inner periphery of the tube, and round the spindle, which runs at $1\frac{1}{8}$ times engine speed. Pressed on to the front end of the spindle is the mild steel hub for both the two-bladed pressed steel fan and the pulley. Four $\frac{1}{4}$ in bolts secure these to their flanged boss. The V-belt is 0·63 in wide and its included angle is 40 deg. Adjustment of belt tension is effected by pivoting the generator on its mounting.

A thrower ring that operates in a drainage space is pressed on to a collar, machined on the spindle behind the bearing. To the rear of this, the diameter of the spindle is stepped down from $\frac{3}{8}$ in to $\frac{1}{2}$ in. There is a water seal round the smaller diameter. Although the seal is by no means new to Vauxhall designs, it is somewhat unusual. It consists of a rubber sleeve that is a tight fit around the shaft, and is flanged at its front end. A brass thimble is pressed over the rear end of the sleeve, and is held in position by the $3\frac{3}{32}$ in diameter, cast iron, pump rotor pressed on the rear end of the spindle. The thimble ensures that the rubber sleeve is always a tight fit around the spindle.

Behind the rubber flange is a pressed brass retaining washer on which is seated a compression spring, which, at its other end, bears against the rotor. The spring presses the flange against a Synco disc, and lugs round the periphery of the disc engage in the rotor casting. Therefore, the whole assembly turns with the rotor, with the



A constant head of oil in the two-piece, hollow rocker shaft is maintained in cups cast on the top of Nos. 1 and 3 rocker pedestals

A three-piece, hollow rocker shaft is employed in the six cylinder engine

disc bearing against a ground face in the pump housing. As the sleeve fits round the spindle too tightly to move independently, wear of the Synco is taken up by the flexing of the rubber flange, the outer periphery of which is at all times maintained, by the compression spring, in contact with the disc.

Water is delivered into the end of the distributor tube in the head, and directed on to the exhaust valve seats and spark plug bosses. A subsidiary thermo-syphon system operates in the full length cylinder jackets. The coolant returns through an outlet on top of the pump to a film-block, or cellular, radiator. In the Velox, this has a frontal area of 340 in², and it is pressurized to 3¼–4½ lb in², while in the Wyvern the system is not pressurized, and the radiator has a frontal area of 225 in². In both units the block thickness is 2·13 in. The coolant capacity of the system for the larger engine is 17½ pints and for the smaller unit 12 pints.

Oil pump, drive, and lubrication

A spiral gear on the camshaft drives the submerged oil pump at half engine speed. The upper end of the boss of the cyanide hardened, mild steel, driven gear is tongued to engage the slotted end of the contact breaker and distributor drive. The ½ in diameter En 43C, pump drive spindle is inserted into the bottom of the gear boss and riveted in position. It is entirely supported in an upward extension of the cast iron, oil pump body. At the upper end, this extension is machined to fit into a boss on the crankcase wall. It is flanged to take two $\frac{13}{16}$ in diameter set bolts, locked with spring washers, that secure it to the lower face of the boss. Axial location of the spindle is effected at the top where the spiral gear boss bears against the end face of the extension of the pump body.

At the lower end the spindle is keyed to the driving gear of the pump. A short, ½ in diameter spindle of bright drawn, case hardening mild steel bar is pressed into the pump body to carry the driven gear. The oil inlet is a drilled boss cast integrally below the pump cover. An oil pressure relief valve is incorporated in the pump body, the blow-off oil being passed to the inlet side of the pump, thus balancing, to some extent, the pressures on each side, and relieving the unit of a certain amount of load.

The sump in the Wyvern holds 8½ pints and, in the Velox, 10 pints. Half-way along it is a transverse baffle, and spot welded to the rear wall is a bracket. These two components carry a pressed steel pan, on top of which is a gauze, approximately 33 in² area. Above the gauze, a 20 S.W.G. steel strip, about 1⅜ in wide, passes laterally across the pan. In it is a 1⅛ in diameter hole, through which a $\frac{13}{16}$ in diameter pump inlet boss projects. A steel washer fits around the boss, and is held against the strip by a compression spring.

From the pump, the oil is carried across the engine by a ⅜ in inside diameter pipe to an adaptor screwed, in the Velox, into the lower face of the rear intermediate crankcase web and, in the Wyvern, into the central crankcase web. From that point, a vertically drilled hole carries the oil to a gallery in the top of the crankcase wall. Towards the front of this gallery is an adaptor for an oil pressure gauge, and bolted on, between this adaptor and the front crankcase wall, is the A.C. by-pass oil filter which discharges downwards to the sump through a vertical drilling in the crankcase. From the gallery, passages in the crankcase webs and in the front and rear walls supply the main journal bearings. The big ends are supplied, in the usual manner, by drillings in the crankshaft. An orifice is incorporated in the connecting rod big end to throw oil up into the cylinder bores. The gudgeon pins are splash lubricated.

Oil is carried, from the main journals through ducts to the camshaft bearings. An axially drilled hole in the rear end of the camshaft connects with a radial one just in front of the rear bearing to prevent the oil pressure from blowing out the Welch plug that seals the rear end of the bearing boss. Behind the timing cover a groove on the rear face of the engine plate passes oil to a small steel tube, supplying a jet feed to the meshing point between the timing chain and its driving sprocket. At the front end, the tube is closed by pinching it, while near the back a collar is up-set. The jet hole is drilled between the collar and the closed end. The tube is inserted into a hole in the engine plate until it comes up against the collar, and the open end is then belled to hold it in position.

A drilled duct from the rear intermediate camshaft bearing in the six cylinder engine, and the centre bearing in the four cylinder carries oil up to an adaptor fitted to the lower face of the push rod chamber. This duct receives an intermittent supply of oil from two inter-connected radial drillings positioned at right angles in the bearing. From the adaptor, which is fitted with a union, a pipe passes up through a boss on the right-hand side of the cylinder head, and is connected to a union on the junction piece between the rocker shafts. The oil feeds in to the hollow rocker shafts, whence it is passed through radial drillings to the rocker bearings. Vertical holes in the rockers allow the oil to pass out and run down over the push rod and valve stem ends. The inner pedestals, for the front and rear shafts, have bosses extending about ½ in above them. These bosses are drilled through to the hollow rocker shafts to form an overflow while, at the same time, maintaining a small head of oil in the rocker lubrication system. The front and rear ends of the rocker shaft assembly are sealed by dished plugs.

Electrical equipment

Lucas electrical and ignition equipment is fitted throughout. A 12 volt system is employed, with a positive earth return and single pole wiring. The output of the C39PV-2 dynamo, driven at 1·62 times crankshaft speed, is regulated by a compensated voltage control. On the Wyvern, a DM2-P79 contact breaker and distributor unit is fitted, while on the Velox a DVZ6A-P80 unit is employed. Both incorporate a mechanical and vacuum, automatic advance and retard control, and they are supplied by a B12 coil. A.C. type V.F.9, 14 mm spark plugs are fitted. The starter is the M.356-1 model. Its pinion has nine teeth and it meshes with 122 teeth on the flywheel ring gear.

Low-temperature Grinding

A METHOD of ensuring that the coolant reaches the actual point of contact of work in grinding operations has been introduced by the DoAll Co., Des Plaines, Illinois, U.S.A. Coolant is fed directly through ordinary vitreous-bonded wheels, which are porous enough to allow flow of the coolant through the wheel to the grinding surface. The coolant flows by gravity from a tank through drip controls into V-grooves on each side of the wheel and thence, through holes, into the wheel itself. Visual gauges are provided, and control of flow is effected by adjustment of the drip controls.

The system was developed to overcome the inherent disadvantages of conventional methods in which coolant is sprayed or pumped on to the workpiece. Although this practice carries away some of the heat, the air current created by the grinding wheel normally drives the coolant away from it so that there is usually little or no coolant immediately under the grinding wheel itself.

According to *Mill and Factory*, April 1952, the actual cutting temperatures when using the new system may be as much as 600 deg F lower than those for more usual methods of cooling. Abrasives cut faster and last longer, and the work is visible during grinding operations. (2028)

GERMAN COMMERCIAL VEHICLES

A Review of Design Trends

By K. B. Hopfinger, M.S.A.E., M.S.I.A.

DURING the immediate post-war period those German commercial vehicle manufacturers whose plant has escaped major war damage continued with the production of only slightly modified pre-war models to meet the urgent demand of the home market. Although production facilities were very limited without exception, technical departments were engaged in developing new models and in studying the technical progress which had been made by foreign manufacturers during the war years. At that time most German commercial vehicle manufacturers were also engaged on repairing allied service vehicles, this enable German designers to obtain first-hand experiences of foreign technical trends. Not until the German currency was stabilized in 1948 was the German automobile industry in a position to undertake the major reconstruction problems and start with the production of new models.

In 1946 13,241 commercial vehicles were produced; almost 80 per cent had a carrying capacity of less than 4 tons. Total production in 1947 was only 13,192 vehicles, but in 1948 the output of commercial vehicles had risen to 28,823. Last year the total production of commercial vehicles reached 92,724, and the total output for the first six months of 1952 is 50,404 vehicles.

During the last two years 43 per cent of all commercial vehicles produced in Germany had a capacity below 1 ton, 46 per cent between 1 and 4 tons, and only 11 per cent capacity above 4 tons. Although the ratio of vehicles in the 1 to 4 ton class may seem relatively high in relation to the vehicles in the class above 4 tons, these German vehicles have a comparatively high tractive output, since they are operated almost invariably with one or even two trailers. The average annual output of four-wheeled trailers produced in Germany has remained almost constant during the past three years at approximately 14,000. The production figures for vehicles suggests there will be an increase in trailer output in the future.

Light vehicle trends

Before the war most German commercial vehicles below 1 ton were three-wheelers. This tendency continued until three years ago, but the majority of operators now favour four-wheeled vehicles in this class. Several present-day German commercial vehicles below 15 cwt have chassis which are only modifications of chassis developed for passenger cars, but most manufacturers are now concentrating on producing special designs for this class of vehicle. Particular attention is being paid to fuel economy. Several 15 cwt vans with as much as 160 cu ft loading space are equipped with twin cylinders two-stroke engines of 600 or 700 c.c. swept volume. Until recently the general tendency was to employ air-cooled two-stroke engines for this type of vehicle, but now there are more water-cooled then air-cooled engines in this particular class. Without exception flat piston two-stroke engines based on the reverse scavaging principle are employed. They have three speed transmission. In the front wheel driven D.K.W. 15 cwt truck powered by a 684 c.c. two-stroke engine of 20 b.h.p. at 3,600 r.p.m. the following gear ratios are :— 1, 1·69 and 3·44 : 1, with a reverse gear ratio of 4·73 : 1. The final drive ratio is 3·5 : 1. It is evident that the rear mounted engines hitherto widely employed in vehicles below 15 cwt will be superseded by forward mounted engines. As most vehicles of this type employ a fully fronted cab there is also a marked tendency to place the power unit within the driver's cab.

For this type of vehicle German designers favour tubular chassis mainly fabricated from straight members and suitably cross braced by pressed steel cross members. To ensure a low loading platform height, torsion bar independent suspension for the rear is favoured although the wheel arches reduce the actual platform area. Where swing axles are employed leaf springs are taking the place of helical coil springs. Telescopic hydraulic shock absorbers are now universally fitted. The loading area on this type of vehicle is normally positioned well within the wheel base, which varies between 7 ft 6 in to just under 10 ft. The rear overhang of the loading platform is normally reduced to a bare minimum. Hydraulic four-wheel brakes with cable operated hand brakes acting on the rear wheels have become accepted features, as have cam and roller steering units.

Without exception all-steel cabs are now employed on commercial vehicles below 15 cwt. Several manufacturers employ light alloy sheets for van body construction, but it is more general practice to use sheet steel in conjunction with a steel frame comprised of hollow drawn square or rectangular profile. For truck platforms, timber is preferred. It is also used as flooring in van bodies. Particular attention is paid to the styling of the cab, see Fig 1, built-in headlamps and chrome decorative strips are current features.

The Volkswagen Transporter

Of outstanding constructional interest amongst German light commercial vehicles is the Volkswagen Transporter, which may be a van or station truck, an 8 seater bus or an ambulance. Current production is 1,300 vehicles per month. This 15 cwt air-cooled rear engine vehicle, see Fig 2, based on Volkswagen car components has a chassis frame of hollow rectangular sections and an all steel body with loading capacity of 134 cu ft.

The experience gained with this vehicle has been followed with keen interest by German commercial vehicle designers, who apart from advocating the use of suitable air-

Fig. 1. A Magirus-Deutz 6½ ton truck, typical of the styling on German commercial vehicles

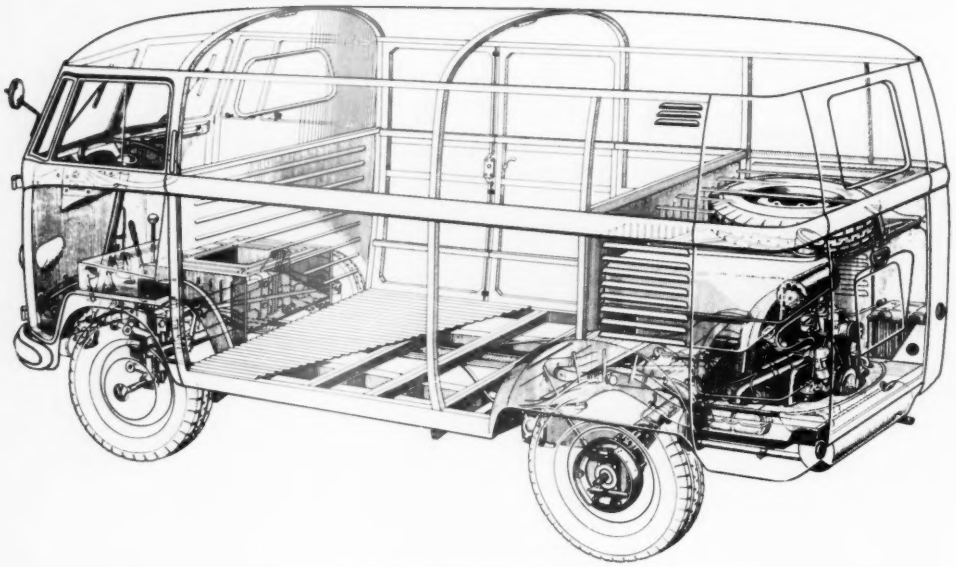


Fig. 2. 15 cwt. Volkswagen Transporter

cooled engines favour van bodies equipped with a double side door allowing more ready access to the small goods normally carried with this type of vehicle. The rear mounted four-cylinder horizontal opposed air-cooled engine unit develops 25 b.h.p. at 3,300 r.p.m. It is housed, together with the transmission incorporating a final drive, with the petrol tank, spare wheels and tools, in a compartment accessible through a large sized top hinged door at the rear of the vehicle. While such arrangement would not prove advantageous in a truck, it is worth while to note that almost 87 per cent of all German commercial vehicles with a capacity below 1 ton are produced with van bodies.

Diesel engines for light commercial vehicles

While as yet diesel engines are not employed in German commercial vehicles below 1 ton there are now trends towards the use of this type of power unit. Air-cooled diesel engines of 1·5 litre swept volume with four-cylinder horizontal opposed or Ve-type are now being installed by several German manufacturers. Four-cylinder experimental engines of this type produced by Richard Kuchen G.m.b.H., Ingolstadt, of 1·5 litre capacity, developing 30 brake horse power at 2,850 r.p.m. and a total weight of 312 lb have been tested successfully in various vehicles.

The price of Diesel fuel in Germany and most continental countries is almost 25 to 30 per cent below the price of petrol. Because of this, operators are prepared to pay the extra cost of a diesel engine, according to independent investigations by various German commercial vehicle manufacturers.

The only diesel engined vehicles below 2 tons are produced by Hanomag of Hanover, in the form of a 1·5 ton and 2 ton chassis with a wheel base of 11 ft 2 in and 4 ft 8 in truck. The four cylinder engine employed has a 90 mm bore and 110 mm stroke and a swept volume of 2·8 litre. It develops 50 brake h.p. at 2,800 r.p.m. with a maximum torque of 105 lb ft at 1,900 r.p.m. This engine has a spherical pre-combustion chamber, a four hole injector which opens at approximately 2,300 lb/sq in and barrel ground cavity pistons. Wet cylinder liners located on substantial flanges in a common cylinder block, a five bearing crankshaft, a gear drive for the cam shaft and injection pump and a single plate clutch are other engine details.

Helical gears are used in the four speed transmission which has the following ratios: 1, 1·83, 3·63, and 6·38 : 1, reverse 7·7 : 1. The spiral bevel final drive has a ratio of 5·16 : 1 and is located in a welded pressed steel banjo housing. On normal commercial German diesel fuel of 0·839 specific gravity, 221 degrees fahrenheit flash, 54·7 cetane number and a heading value of 18,450 B.Th.U lb, the vehicle, laden with 1·5 ton has a fuel consumption of 29·7 miles per gallon when driven at a constant speed of 30 m.p.h. The chassis has an all-steel driver cab, a full width seat for three persons and alligator type engine bonnet which can be locked from within the cab.

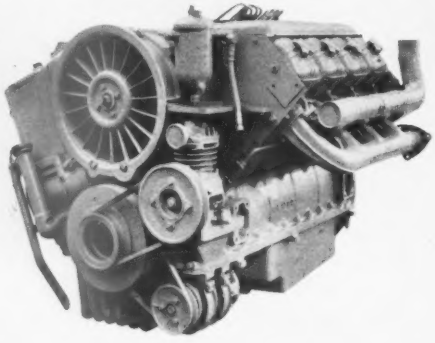


Fig. 3. Magirus-Deutz air-cooled V-eight diesel engine

Commercial vehicles between 1 and 4 tons

Most of the German vehicles now being produced in this class are powered by diesel engines, but Adem Opel A.G. and Borgward G.m.b.H. still offer 1·5 ton trucks with petrol engines. The German Ford Company

although still producing a range of 1·5 ton to 4 ton trucks with petrol engines does offer diesel engines as alternatives for 3 and 4 ton chassis.

For medium heavy transport, German and Continental operators show a preference for the 3·5 ton truck powered with a diesel engine of approximately 90 b.h.p. The engine must have good tractive power, be capable of an average speed on the "Autobahn" of approximately 35 m.p.h. and a maximum speed of approxi- 50 m.p.h. Fuel consumption must be not less than approximately 18 miles per gallon.

Daimler-Benz, with a monthly output in the order of 1,200 vehicles have the largest German production of 3·5 ton chassis. The 4·5 litre 6 cylinder diesel engine has an inclined pre-combus- chamber and develops 90 b.h.p. at 2,800 r.p.m. It is basically identical with the Company's pre-war engine except for certain detail modifications introduced during the past two years. These modifications exemplify some typical trends in German engine design.

Fig. 4. Arrangement of the combustion chamber on the new 8·2 litre Daimler-Benz diesel engine

Daimler-Benz commercial vehicle diesel engines are now equipped with a thermostatically controlled engine oil cooler in the shape of labyrinth passages incorporated adjacent to the water jacket of the cylinder block. Through this modification it was found practical to reduce the capacity of the oil sump by almost 30 per cent on the 4·5 litre 4 cylinder engine and on the 7·3 litre 120 b.h.p. 6 cylinder engine the sump capacity was reduced from 4·5 gallons to 2·5 gallons.

Rubber bonded torsional vibration dampers are fitted to the forward end of the crankshaft. The solid cast cylinder block contains a percentage of chrome-nickel. The top two of the four piston rings are chrome-struck. There is a scraper ring on each side of the gudgeon pin bore of the forged light alloy piston. The gudgeon pin is pressure lubricated and a jet on the big end delivers a timed spray to the cylinder wall. Four-point rubber engine mountings are employed and the lower half of the flywheel and single plate clutch is exposed.

Five speed constant mesh gear boxes are now invariably fitted in German commercial vehicles of the 3·5 ton class. Auxiliary gear boxes are available as optional equipment with most chassis, but the double reduction back-axle is not favoured by German designers for this class of vehicle. A differential lock and fully floating back-axle is regarded as essential and is employed in the majority of vehicles.

Most steering gears are of the worm gear pattern used in conjunction with fairly large diameter steering wheels. German commercial vehicle manufacturers and operators, because of the higher road speeds permitted on the Continent, are very interested in power assisted steering units. This type of steering gear is not yet offered as standard equipment, but three component manufacturers are engaged on the development of such units. Particular interest is being shown in power operated steering units working on a hydraulic principle. Alternatively, air pressure operated units are favoured in some quarters.

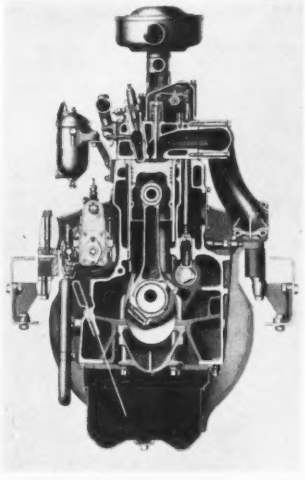


Fig. 5. Bussing, 6 cylinder, 180 b.h.p. engine

Chassis frames comprise in almost every case of wide flanged channel section, side members with pressed steel cross members cold riveted into position. On some long wheelbase chassis, tubular cross members with welded end flanges suitably dimensioned to allow riveting are employed in addition to the pressed steel cross members.

Without exception suspension is by semi-elliptic leaf springs with large dimensioned shackle bolts in sleeved bearings. Auxiliary leaves are preferred for the rear springs and on most chassis double acting telescopic shock absorbers are fitted to the front suspension.

Some manufacturers employ hydraulic continuous flow brake systems in connection with conventional shoe brakes; two leading shoe brakes have not as yet found favour. For operation with trailers, hydraulic brake systems are offered in connection with air pressure systems. While several manufacturers now use umbrella type hand brake levers fitted parallel to the steering column, hand brake operation has remained by mechanical linkages to the rear wheel.

Most German commercial vehicle chassis of 3·5 ton are equipped with brake drums of 16 in diameter, widths of the front brake shoes being 3 in or above, widths of the rear brake shoes 4 in or above. A frictional area of 55 to 60 sq in per gross ton weight is not uncommon. Compensated-controlled electrical systems of 12/24 volts are still most commonly employed, but a 12 volt compensated voltage controlled system with positive return is also widely used.

Particular attention is paid to the design and layout of driver cabs, which in some instances are separated from the engine compartment. They are becoming more spacious, and without exception are lined with plastic or cellular materials for sound insulation. Wind screen demisting, fresh air heating and ventilation systems have become standard features, as have large windscreens and windows. Tool kits laid out in fitted trays are normally housed within the driver's cab. Provision is also made for luggage lockers underneath the bench seats, the type generally employed. Owing to the fact that in this class of German vehicle the normal driving position is behind the engine, fully fronted cabs are not employed.

Power units for vehicles above 3½ tons

During the last war production of automotive diesel engines came to a standstill in Germany because for strategic supply reasons the petrol engine was standardized for military

Fig. 6. Magirus-Deutz 6½ ton chassis

requirements. Nevertheless, German vehicle manufacturers were in a position to continue with some research work on diesel engines. Post-war diesel engines show that most of this research work was applied only to specific engine details such as combustion chamber and piston design, use of materials etc. The only major diesel engine development in post-war Germany which has already reached production stage is the Magirus-Deutz air-cooled engine.

Magirus-Deutz air-cooled diesel engines, designed on a unit construction principle, employ individual cylinders of 110 mm bore and 144 mm stroke, with individual cylinder heads. The present production programme includes a 2 and 3 cylinder engine for agricultural tractors. For use in commercial vehicles, four-cylinder engines of 82 brake h.p. at 2,300 r.p.m., 6 cylinder of 120 brake h.p. at 2,250 r.p.m., a V-six cylinder of 120 brake h.p. at 2,250 r.p.m. and a V-eight cylinder of 160 brake h.p. at 2,250 r.p.m. are being produced The V-eight engine is illustrated in Fig 3. While the Company employs only the 4 cylinder and V-eight cylinder engine in its own commercial vehicle programme, they and the other engines mentioned are also supplied to various German vehicle manufacturers. During the past 4 years over 27,000 vehicles have been equipped with this type of engine.

Technical details of the latest Magirus-Deutz engine include a tangential positioned spherical steel combustion chamber cast into the light alloy heavily finned cylinder head, laminated steel cylinder head gasket in the form of a flat ring, and pressed steel welded inlet and exhaust manifolds with mild steel flanges. Cooling is effected by axial turbo blowers that deliver air over the sheet metal encased cylinder and cylinder head. In the four cylinder engine the blower is belt driven and has an output of 2,500 cu ft of air per minute, while a shaft-driven blower unit with an output of 4,000 cu ft per minute is employed in the V-eight cylinder engine.

The latest engines produced by Henschel and Sohn G.m.b.H. employ a modified lanova air cell combustion system, using now a flat topped piston with slight alteration to the shape of the air combustion chamber and air cell, a single hole fuel injector, opening at approximately 1,800 lb sq in sprays diametrically across the waist of the combustion chamber towards the air cell. These modifications have considerably improved the idling and smooth running of the engine. The Henschel 5·4 litre 6 cylinder engine develops 95 brake h.p. at 2,200 r.p.m. and is also supplied as a replacement engine for German, American, British and French commercial vehicles.

Daimler-Benz A.G. still use a single hole fuel injector in an inclined pre-combustion chamber with a rather large open ended duct for the 90 brake h.p. six cylinder 4·5 litre engine, but the latest 145 brake h.p. six cylinder 8·2 litre engine has a multi-hole nozzle and a single spherical depression in the piston crown. The arrangement of the combustion chamber is shown in Fig 4. This modification resulted in approximately 15 per cent improvement in fuel consumption.

The only direct injection two-stroke engine at present in production in Germany is that manufactured by Sudwerke G.m.b.H. This engine is of the uniflow type with a Roots two-lobe blower and two overhead exhaust valves per cylinder. It has a single hole injector mounted vertically above the centre of a circular depression in the piston crown. The opening pressure of the injector nozzle is 2,945 lb sq in. A 5·8 litre four cylinder engine with an output of 135 b.h.p. at 1,700 r.p.m. and an 8·7 litre six cylinder engine of 190 b.h.p. at 1,700 r.p.m. are also produced by Sudwerke. Another two-stroke cycle diesel engine, but one employing loop scavaging will shortly be put into production by Krauss-Maffei. Complete constructional details of this engine were published in the July 1952 issue of the "*Automobile Engineer*".

Only one under-floor engine, the Bussing, is produced in Germany. It is employed to a limited extent in commercial vehicles manufactured by Bussing G.m.b.H., but is used extensively in the Company's passenger service vehicle programme. The Bussing 13·5 litre six cylinder under-floor engine with 130 mm bore and 170 mm stroke, developing 180 brake h.p. at 1,600 r.p.m. is employed in a 12 ton chassis. The Koerting pre-combustion ante-chamber system positioned vertically in the cylinder head is employed, see Fig 3. Fuel is injected through a four-hole pintle-type nozzle at 1,540 lb sq in. Three of the holes are into the blind end of the cylinder shaped ante-chamber towards three "broad arrow" depressions in the piston crown. Wet cylinder liners, and a torsional vibration damper complete the otherwise conventional details of the Bussing underfloor engine.

For the 6 and 8 ton chassis Bussing employ a conventional six cylinder 7·9 litre engine of 120 brake h.p. at 1,800 r.p.m. and a six cylinder 13·5 litre engine of 180 brake h.p. at 1,500 r.p.m. These also incorporate the Koerting pre-combustion ante-chamber system.

On German Diesel engines the most

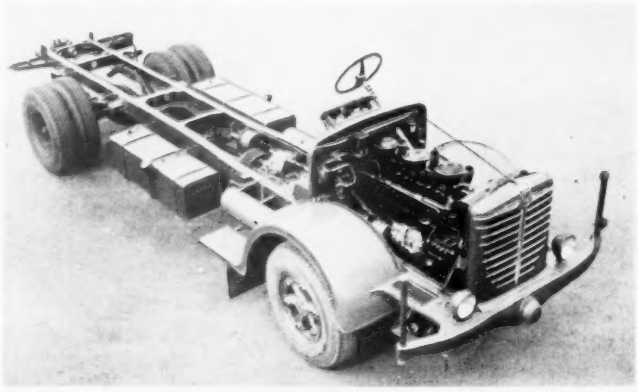


Fig. 7. Bussing 8 ton chassis

widely used additional cold starting aid apart from glow plugs is an electrical heater coil arranged in the manifold of the air intake flange.

Trends in chassis above 3·5 tons

Technical details of chassis design in German commercial vehicles above 3·5 tons vary only slightly from the general practice adopted by manufacturers in the United Kingdom. In general, German chassis frames are of slightly stronger construction, because the vehicles are usually operated with one or two trailers. Indeed, it is not unusual for a 6 ton vehicle to haul loads in the order of 36 tons. The use of narrow frames for rigidity with the rear cross member supported from the second member through the side member to the spring brackets has become an accepted post-war feature by various German vehicle manufacturers. Typical chassis are shown in Figs 6 and 7.

Without exception compressed air braking systems are preferred. Many have twin operating cylinders acting on a single cross shaft and multi-pull hand-brake mechanism. The total frictional brake lining area for vehicles in the 6 ton class is seldom below 550 sq in and 17 in diameter brakes with a width of 4 in in the front and 6 in in the rear are generally employed for this class of vehicle.

Engine brakes in the form of exhaust obturators attached to the exhaust manifold are now intial equipment on most vehicles. They may be operated either from a conveniently situated hand lever or from a foot pedal. The actuating lever or pedal is interlinked with the accelerator pedal and the injection pump control as a precautionary measure.

Five or six speed gear boxes are normally employed in German vehicles above 3·5 ton, sometimes in connection with a double ratio auxiliary gear box. Only one organization, Henschel and Sohn G.m.b.H., uses a four speed transmission in conjunction with a double reduction ratio back axle. The first reduction is through bevel gears and the second through helical-tooth spur gears. Henschel are the only commercial vehicle manufacturers producing their own transmission and final drives.

Low geared steering units of the worm gear pattern with exceptional large steering wheels, and ensuring light handling, are the present trend. There is however every indication that power assisted steering units at present under development by at least three component manufacturers will be adopted in the not-too-distant future. Drivers' cabs for this class of vehicle are particularly roomy and well equipped, usually there is ample room for four people. For vehicles that are employed on long distances ample luggage space and a sleeping bunk behind the driver's seat are general features. Separate large size fuel tanks on either side of the chassis and spare wheel carriers with a variety wheel lifting mechanism are now found on most vehicles.

Four-wheel driven vehicles

During recent months most German commercial vehicle manufacturers have started to introduce four-wheel drive vehicles of 3·5 ton and in some cases of 6 ton capacity. This marked development is due to the demand for such vehicles for constructional purposes in Germany and most overseas countries, and also in connection with the Western Defence programme.

German four-wheel drive vehicles already in production vary generally little from those manufactured in the United Kingdom, except where the vehicle is produced for specific defence purposes. Most vehicles are designed for operation as load carriers or prime movers and are also equipped with power winches. A double ratio transfer gear box is normally arranged immediately behind the main gear box and connected by tubular propeller shafts to bevel and helical gearing of the fully floating front and rear axles. Air pressure operated brakes with a total frictional area of 600 sq in are normal in German 3·5 ton four-wheel drive cross-country vehicles. A 3·5 ton Mercedes-Benz four-wheel drive chassis is shown in Fig 8.

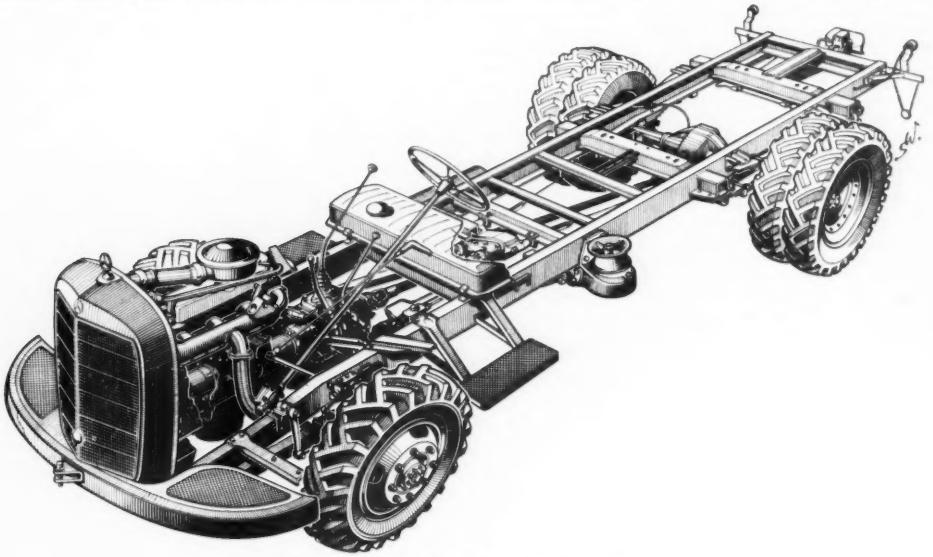


Fig. 8. Mercedes-Benz 3½ ton, four-wheel drive chassis

Conclusions

At present general tendencies in German commercial vehicles do not reveal any entirely novel trends. Efforts are concentrated rather on detailed developments for improving existing designs. Many of these are types that were orginally introduced shortly before the last war.

The post-war recovery of the German motor industry and the world demand for vehicles has opened to the German commercial vehicle manufacturer export markets demanding vehicles which can compete with those produced in other countries. Sturdy design, a high standard of workmanship and good deliveries has enabled the German industry to gain a foothold since the war in certain overseas markets hitherto never supplied by it before.

S.G. CAST IRONS

Notes on the Properties and Uses of an Important Material

IT is perhaps an exaggeration to claim, as some do, that the development of processes for the direct foundry production of grey iron castings with free graphite in the nodular form is the greatest metallurgical advance of the century. Nevertheless, it is a development of very great importance to engineers. Because of this, a paper presented before the 4th International Mechanical Engineering Congress by Dr. A. B. Everest of the Mond Nickel Co. Ltd. on *The Engineering Properties and Applications of Spheroidal Graphite Cast Iron*, on which these notes are mainly based, is of extreme interest.

Essentially, the process employed for this material produces a structure with graphite in spheroidal form in place of the flakes found in grey cast iron. Cerium was first used as an additive to produce the desired structure, but more recently a process has been developed which calls for the introduction of small proportions of magnesium under specified conditions. This magnesium process is now commercially established in all the leading industrial countries, since it has proved to be the more adaptable and economic. Various designations are used for the product of the magnesium process. Of these, technically the most accurate is "spheroidal graphite cast iron" or for short, S.G. iron.

The magnesium process for making this iron can be applied under all normal foundry conditions. Most types of cast iron that usually show flake graphite can be modified to the spheroidal graphite form by appropriate treatment. Nor does the treatment present any special difficulties. In fact, all the normal forms and sizes of castings made in grey cast iron can equally well be produced in S.G. iron.

Main types

S.G. irons provide a wide range of new properties and characteristics in iron castings. In reviewing the engineering properties and applications of S.G. iron, two main types must be considered. Ordinary compositions of the iron when cast into sections ranging from approximately $\frac{1}{2}$ in to 2 in thickness will normally have a pearlitic matrix. This matrix is similar to that found in ordinary high duty cast iron, and corresponding to high carbon steel, in which about 0·6 to 0·8 per cent of the carbon remains combined. The strength of the matrix itself is about 60 tons per square inch.

Sections which are quickly cooled, and particularly those below $\frac{1}{2}$ in thick, tend to chill as in the case of ordinary grey cast iron. As a result a higher proportion of the carbon present is retained in the combined state; in the extreme case, all the carbon is combined, giving a hard white cast iron devoid of free graphite. Magnesium-treated cast iron, which exhibits such chill, can readily be softened by annealing at about 900 deg C for a few hours, followed by slow cooling. Such treatment results in the breakdown of the combined carbon, to give a structure in which the matrix consists of ferrite and all the carbon is present as spheroidal graphite. Sections of the castings which cool more slowly, for example, those in excess of 2 in thickness, generally show a structure containing a mixture of pearlite and ferrite. In practice, S.G. iron is generally used either as-cast, with a predominantly pearlitic matrix, or annealed to the ferritic type, but mixed structures are often obtained in as-cast heavier sections.

PROPERTIES OF S.G. IRON AS CAST AND ANNEALED COMPARED WITH HIGH DUTY FLAKE GRAPHITE CAST IRON

Property		High Duty Flake Graphite Cast Iron	S.G. Iron	
			As Cast	Annealed
Ultimate Tensile Strength	tons in^2	18—22	35—45	27—35
Yield Point	tons in^2	—	25—35	20—25
Elongation	per cent	Nil	1—5	10—25
Transverse Rupture Stress	tons in^2	38—42	55—65	55—60
Compressive Strength	tons in^2	60—65	65—80	48—58
Compressive Yield Strength	tons in^2	—	32—40	24—32
Elastic Modulus	lbs in^2	18×10^6	25×10^6	25 ± 10^6
Brinell Hardness		210—240	230—280	140—180
Impact Izod 10 mm sq, notched	ft lbs	1	4	12
Impact Charpy 10 mm sq, unnotched	kgm	0·3	1·1	10
Endurance Limit, Unnotched	tons in^2 ±	8·5	13—18	11—13
Endurance Limit, notched, 0.05 in rad	tons in^2 ±	8·0	9·5	8·2
Endurance Ratio, unnotched		0·43	0·34—0·38	0·37

Mechanical properties

The modification of the graphite in cast iron from the flake to the spheroidal form produces a substantial improvement in the mechanical properties, since the inherent qualities of the steel-like matrix are more nearly realized in the castings. The mechanical strength is at least doubled for the various matrix types, while the castings show measurable ductility and their shock resistance is increased several times. A list of mechanical properties at present available for S.G. iron in comparison with high duty flake cast iron is given in the accompanying table. The figures quoted for the more common properties are based on a wide experience of the production of S.G. iron. For the more specialized properties, the data are in some cases meagre, and the figures apply only to one or two particular compositions.

Attention may be drawn to the following features revealed by the list of properties:—

Yield point. The stress - strain curve for S.G. iron differs in form from that of ordinary cast iron. Flake graphite cast iron shows no definite yield or proportionality limit, and properties such as the elastic modulus are estimated by the initial slope of the stress-strain curve. For S.G. iron the curve approaches more nearly to the form shown by steel. There is a distinct relationship between stress and strain until a distinct yield point is reached. Some authorities claim that the curve shows a limit of proportionality at a figure lower than the yield strength. In practice, however, the yield point is regarded as the significant feature. It is usually measured by the 0·2 per cent proof stress. A particular feature of S.G. iron is the high yield point revealed in such test. It is of special significance that in this respect S.G.

iron is markedly superior to malleable cast iron, being able to sustain higher loads without permanent deformation.

Elastic modulus. The high elastic modulus, approximately 25,000,000 lb/sq in, should be noted, since it signifies less deflection for a given load. This figure has been confirmed by many workers and is independent of the matrix condition. The combination of the high yield strength and elastic modulus of cast iron is important, in that whilst the new cast iron has sufficient ductility to show deformation by twisting and bending, it is at the same time stiff and rigid, and considerable force is required to initiate deformation.

Hardness. Generally, the Brinell hardness of S.G. iron is from 20 to 40 points higher than that of flake graphite iron of corresponding matrix structure. This should be considered in relation to the good machinability of S.G. iron. It is of advantage in applications for which wear resistance is important.

Impact properties. The impact strength of S.G. iron has been determined by using the 10 mm notched Izod impact test piece standard for steels. Hitherto this test has been unsuitable for cast irons, since it gave figures below the range of accurate measurements. As shown in the table, the annealed S.G. iron has an impact strength twelve times that of flake graphite iron; this brings it into the range suitable for test by the Izod method. A more satisfactory test for shock resistance is the Charpy. Values are given in the table for the Charpy impact strength in kgm per cm^2 on a $10 \times 10 \times 40$ mm span unnotched test piece. It must be noted that the impact figures are sensitive to composition. For maximum shock resistance it is essential that the phosphorus and silicon should be kept as low as possible.

Endurance limit. Available data show that S.G. iron follows the general rule that endurance ratio falls with increasing tensile strength. The actual limiting strength in fatigue strength is markedly superior to that of other cast irons and of cast plain carbon steel. This is of considerable importance for moving parts.

Production characteristics

S.G. irons have already been used for many types of castings for which flake graphite was previously employed. They can be used for castings from $\frac{1}{16}$ in to 40 in thickness, and with weights ranging from an ounce up to 50 or 60 tons. Naturally, the light section castings are always annealed, but annealing is neither practical nor necessary for the larger ones. All normal foundry production methods, including sand, chill and centrifugal casting, can be applied. The following properties are of interest in connection with the production of S.G. iron castings: —

Section sensitivity. In common with other cast metals, the mechanical strength and other properties of S.G. irons tend to fall with increasing section thickness. It has been shown, however, that the fall in properties with increase in section is less for S.G. irons than for flake graphite cast irons. At the higher level of mechanical properties shown by S.G. irons under all conditions, large sections have at least three times the strength of similar forms in flake graphite irons.

Pressure tightness. If proper foundry technique is employed, there is no special difficulty in the production of pressure tight castings in the new irons. Complicated castings can readily be made, and the new iron has been employed successfully for designs for which steel is unsuitable owing to casting difficulties, and ordinary cast iron is unable to provide the necessary strength to meet the pressure test conditions.

Machinability. Both as-cast and annealed, S.G. iron has excellent machining qualities and takes a high degree of surface finish. In the annealed condition it gives long, continuous turnings. Considerable study has been carried out on the machinability of S.G. iron. The general conclusions are: for similar matrix structures, S.G. iron and flake graphite cast iron have similar machinability properties; at equivalent hardness or strength levels S.G. iron has markedly superior machinability. This property was discussed in detail in *Automobile Engineer* for January 1952.

Weldability. S.G. iron can be readily welded by normal technique. Arc methods have been used successfully, and the latest information is that the new iron may also be welded by gas methods. A magnesium-treated cast iron rod is used, and the deposited weld metal is good spheroidal graphite cast iron.

Modifications

Ordinary cast irons are, of course, produced with many modified types of matrix. The new process is concerned essentially with the control of graphite form, but can be applied to all known types of grey cast iron with beneficial results. Some of the special modifications of S.G. iron are: —

Chilled castings. If desired, surfaces exposed to wear can be hardened by chilling. Rapid cooling of the metal against the chills results in the retention of a high proportion of combined carbon in lighter section castings, giving a hard wear-resistant iron facing. The grey cast iron behind the chilled surface will assume the spheroidal form. This is important in the production of chilled castings with improved mechanical properties.

Alloyed structures. Magnesium treatment has been applied to castings alloyed to develop special matrix structures. Examples are, castings containing about 4·5 per cent of nickel to give a hard, wear-resistant martensitic structure, and castings with the acicular matrix produced by alloying with nickel - molybdenum. Mechanical strength figures of 60 tons/sq in for S.G. acicular cast iron have been developed in combination with high toughness, shock resistance and wear resistance. Corrosion resisting austenitic S.G. irons have also been developed.

Heat treated cast irons. Combinations of high hardness and wearing quality with high strength and toughness can be produced in S.G. cast irons by different heat-treatment processes, including quenching and tempering, normalizing and iso-thermal treatment.

Surface treatment. S.G. iron may be surface hardened by flame and induction processes to give hardness in the order of Rockwell C58-60. Surface treatments such as carburizing and nitrogen hardening can also be applied.

Centrifugal casting. S.G. iron is suitable for casting by the centrifugal method for such components as cylinder liners. In many cases of thin-walled castings, the parts as-cast are white and require a short annealing to break the as-cast structure down to the spheroidal graphite grey type.

Service properties

The service properties of materials are of fundamental importance in engineering applications. Many of these properties cannot be adequately assessed by laboratory tests. So far as resistance to wear and the effects of heat and corrosion are concerned, the available data is: —

Wear resistance. Dry wear tests on S.G. iron have given variable results. Some tests have shown good resistance, but in other unlubricated tests S.G. irons proved inferior to flake graphite irons. Good results have been reported for S.G. iron under lubricated conditions.

Heat resistance. Tests indicate that the heat resistance of S.G. iron is much superior to that of flake graphite iron. The new iron proves much more resistant to growth and oxidation and has greater stability at elevated temperatures than the conventional cast irons. Undoubtedly, the greater stability of the metallic matrix of an S.G. iron is a predominant factor in preventing the passages of gases into the metal, thus reducing internal oxidation and growth. For higher temperature service, special grades of S.G. iron such as the austenitic or high silicon types may be considered.

Corrosion resistance. With minor variations, the corrosion resistance of S.G. iron is approximately the same as that of flake graphite irons. For conditions of severe corrosion, the austenitic S.G. irons are available.

Applications

There are many applications in the automobile industry for which S.G. iron may be used with advantage. They include: —

Clutch bodies, as-cast or annealed.
Clutch plates, as-cast.
Gearboxes and housings, annealed
Wheel hubs, annealed.
Pedal levers, annealed.
Brake drums, as-cast or annealed.
Brake shoe segments, annealed.
Cylinder heads, as-cast or annealed.
Cylinder liners, as-cast.
Piston rings, as-cast.

Crankshafts, as-cast.
Timing gears, as-cast or annealed.
Camshafts, as-cast; chilled noses.
Rocker arms, annealed; chilled pads.
Flywheels, as-cast or annealed.

For most applications, an S.G. iron will be adopted, not because of one special property but rather because of a combination of properties. For example, light sections can be produced with good hardness and wear resistance combined with properties approaching those of malleable cast irons. This opens a large field for the use of S.G. irons as economic substitutes for malleable iron castings. These irons may also be used for machine tool parts, engine liners, piston rings and even small connecting rods, where strength with wear resistance under lubricated conditions is required. There is also the possibility of using S.G. iron for blanking dies. The die can be cast accurately to form, and after finishing, the cutting edges may be further hardened by local heat-treatment, such as flame or induction hardening.

There is no doubt that the better mechanical properties will generally be the reason for adopting S.G. irons in place of flake graphite cast irons, because they will afford equal strength with lighter sections. Even if a reduction in section size is impossible, there may still be good reason for changing from a flake graphite iron to an S.G. iron. For equal strength with equal section the S.G. iron can be used with a structure that will give it machinability greatly superior to that of the flake graphite iron. This could lead to appreciable production economies, since it would lead to an increase both in the production rate and in tool life.

SYNTHETIC RESINS

Some Materials for Use in Foundries

AMONG the many interesting materials developed by Imperial Chemical Industries Limited, Plastics Division, Welwyn, are several synthetic resins for use in foundries. That these resins are being used to an ever increasing degree is a direct result of certain advantages, both technical and economical, that they have over more conventional foundry materials, particularly for sand core binding. In addition, their hardening properties have made possible new processes and techniques. For example, the sand shell moulding process, the surface hardening of sand moulds, and the use of dielectric heating for drying sand cores have all been made possible through the use of synthetic resins.

Sand core binding

There are two types of synthetic resins for use as sand core binders, urea formaldehyde (U.F.) and phenol formaldehyde (P.F.) resins. U.F. resins are now widely used in the larger mechanized non-ferrous foundries for sand core binding. The chief advantages they offer are:—

(1) At the present time U.F. resin binders can be supplied at £79-£80 per ton, a relatively low cost in comparison with the majority of binders available. Satisfactory cores can be made with quite small quantities of resin binders.

(2) The drying time is shorter than for oil-bound cores. Drying time varies with the size of the core and the differential increases with core size. U.F. resin bound cores of over 100 lb. weight may be baked in under two hours against ten hours or more for many types of oil-bound cores. If dielectric heating is used, U.F. resin bound cores may be dried in a few minutes.

(3) For U.F. resins the breakdown temperature is 220-270 deg C. against 450-500-deg C. for linseed oil. Therefore, in non-ferrous casting, with its comparatively low casting temperatures, U.F. resin-bound cores show rapid and complete breakdown and freedom from faults in the castings due to insufficient core collapse.

P.F. resins have a breakdown temperature of 400-450 deg C., which is little lower than that of linseed oil. Apart from this their properties are generally similar to those of U.F. resins. Because of the breakdown temperature, P.F. resin-bound cores are suitable for all types of ferrous casting. These cores show a very low gas evolution during burning out, a factor that contributes towards freeing the foundry from objectionable fumes.

Dielectric heating

With dielectric heating it is possible to dry resin-bound cores in a few minutes, a substantial time saving over conventional oven drying. Special U.F. and P.F. resins have been developed for use as core binders where dielectric heating is employed. This technique is especially suitable for mass production foundries. A problem peculiar to dielectric drying of cores has been overcome by the development of an entirely different type of resin, the polyester, for the manufacture of core carriers or dryers. The function of the core carrier is to support the sand core during drying, and for dielectric drying the core carrier must have the following properties:—

(1) Suitable electrical properties to prevent energy loss with consequent overheating of the drier.

(2) Dimensional stability.

(3) Robustness.

(4) Ease of manufacture and economic production cost.

(5) Good surface and detail.

Investigations have shown that carriers based on polyester resin-sand-glass fibre formulations are most suitable for this drying technique.

Surface hardening of sand moulds

Sand moulds, in contradistinction to sand cores, are substantially "green sand," that is, the sand contains little or no binder. Such sand moulds have over a long period been found satisfactory for most types of casting. On certain moulds, however, there is a tendency for the surface of the "green" sand to be washed away by the flow of molten metal. A technique for surface hardening moulds, based on accelerated U.F. resins, is proving to be an economic method of overcoming this problem.

It is possible to spray the mould with a mixture of U.F. resin and accelerator, which will harden within an hour at normal temperatures, or within minutes under heat. This treatment produces a surface-hardened "green sand" mould with greatly improved resistance to washing and pitting during casting. From this it is thought that it should be possible to make many types of cores with a "green" interior inside a hardened skin. Such cores would offer appreciable advantages over the present core making technique.

Sand shell moulding process

Essentially, this moulding process is a method by which thin shell sand moulds suitable for use as casting moulds may be rapidly produced. The process involves the use of a dry sand-resin mixture, the resin being a powder P.F. type. This dry mix is allowed to fall on to a heated metal pattern surface, where it softens to form a thin shell adhering to the pattern. The pattern and shell are then transferred to an oven. Within a few minutes, the sand shell hardens and may be lifted from the pattern. Total cycle time for making the finished shell mould is from three to five minutes.

This method lends itself to high precision casting. The sand shell reproduces fine definition from the pattern surface, and when used as a mould imparts equally good definition to the casting. Thin metal sections are readily cast by this method. The type of resin developed for this application is a P.F. powder of fine mesh. It is capable of softening rapidly and then hardening in a few minutes at the pattern temperature, that is at approximately 450-500 deg C. Normally from six to eight per cent resin is used in the sand mixture.

MACHINE TOOLS

Pre-view of the Forthcoming International Machine Tool Exhibition

FOR the first time since 1934, the International Machine Tool Exhibition to be held in Olympia, London, from September 17th until October 4th, 1952, will live up to its title and be truly international in character. The 1948 exhibition was deservedly acclaimed as one of the finest engineering exhibitions ever organized in this, or any other, country, but Continental exhibits were confined in the main to Swiss products, with a smaller number of Belgian machines. This year the exhibition will have greatly increased interest, since German machine tools will be shown in great numbers, and there will also be a goodly number of Italian machines.

The very wide selection of Continental machine tools will be of added interest, because since devaluation occurred, American products have become so expensive that only the most compelling reasons can warrant their import into this country. In fact, unless the American machine tool is of a type that cannot be obtained elsewhere, some Gleason machines are examples, there would seem to be little point in buying them.

Chief interest will necessarily centre on British machine tools. Many machines of new design will be on view, but most of these will be logical developments of, rather than breakaways from, established practice. It is perhaps unfortunate that some important developments of particular interest to the automobile industry cannot be demonstrated at an exhibition such as this. For example, the several interesting transfer machines which have been developed in recent years cannot be shown. Nor is it possible to show what has been done to expedite production and reduce handling by grouping several machine units round a common work fixture. In general, the developments are all towards higher rates of metal removal, increased precision and better finish on the work.

It must be stressed that this pre-view is far from being comprehensive. Limitations of space have prevented even the briefest mention of such items as measuring instruments, small tools and heat-treatment equipment, although there will be interesting displays of all these. Only machine tools are discussed, and even so it is possible to mention only a small proportion of the total exhibits. The selection of machines to be mentioned has necessarily had to be rather arbitrary, but an attempt has been made to deal, however briefly, with those that will be of greatest interest to the automobile and ancillary industries.

Abwood Tool & Engineering Co. Ltd.

(*Stand No.* 93—*Grand Hall*)

Of the products that are to be shown by the Abwood Tool and Engineering Co. Ltd., Princes Road, Dartford, Kent, the carbide tool grinding and lapping machines will be of most interest to engineers in the automobile and ancillary industries. There will be three machines, two pedestal-mounted and one for bench mounting. The most completely equipped of these machines is the "Concentre" which in addition to being designed for grinding and lapping, also has a chip breaker grooving attachment. This machine incorporates large machine-divided scales for easy and accurate table setting. Table angles are adjustable 30 deg above and 9 deg below zero. The protractor rest is made in bronze, dull chrome plated for durability. It has a machine-divided scale that can be indexed to any angle up to 75 deg on either side of zero.

Adcock and Shipley Ltd.

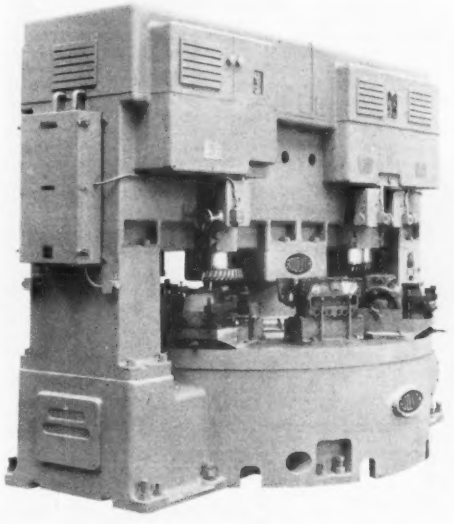
(*Stand No.* 105—*Empire Hall*)

Milling machines of various types and in a wide range of sizes, and three drilling machines will be exhibited by Adcock and Shipley Ltd., Ash Street, Leicester. The milling machines typify the very wide range of duties for which this firm has developed products. There is, for example, the model 1G horizontal miller, a simple hand feed machine with lever feed to the table, screw feed to the cross-slide and lever feed to the knee. It has 18 speeds in the range 50 to 2,500 r.p.m.

A machine that is very suitable for light milling operations on mass-produced or batch-produced components is the model 0AD horizontal miller with the Multiform feed mechanism. This mechanism is primarily intended to allow the operator to use a lever to give rapid approach of the work to the cutters when the normal auto-feed mechanism is engaged. At the end of the milling operation the machine is automatically stopped, and the same lever can then be used to return the table to the loading position at rapid traverse rate. Various models of this machine are available, with different spindle speed ranges. The machine to be shown has 12 speeds from 150 to 3,000 r.p.m. with feeds from 0·003 to 0·009 in per spindle revolution.

A very heavy duty milling machine, model 4AG, will also be shown. It has been designed to allow full use to be made of the metal removal properties of carbide-tipped tools, particularly when negative rakes are employed. It is therefore a very rigid machine. Normally, a 25 h.p. motor is fitted. This gives sufficient power for the heaviest cuts likely to be used. An important feature is that there is an infinitely variable feed rate. This allows the tooth load to be accurately controlled. A backlash eliminator is fitted to make the machine suitable for climb milling.

In addition to their wide range of standard drilling and milling machines, Adcock and Shipley Ltd. have been responsible for the development of many special purpose machines. One of these, a deep-hole drilling machine, will be exhibited. It has an indexing turret to allow loading and unloading to be carried out at one station while drilling is proceeding at another. When the machine is started, the heads advance to the drilling position at 300 in per minute. Drilling then starts at a suitable feed rate and continues to a predetermined depth, when the heads retract at 300 in per minute.



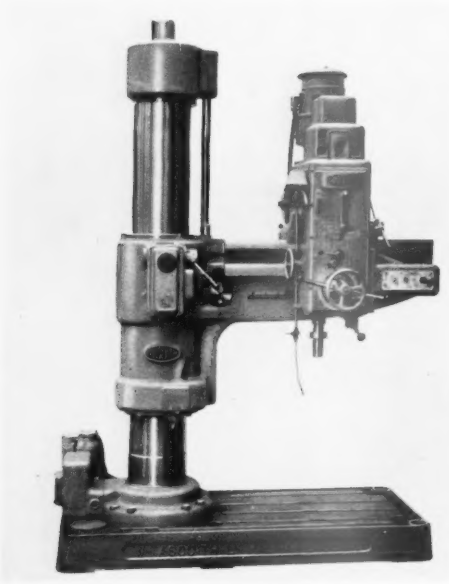
Continuous rotary milling machine
(*William Asquith Ltd.*)

William Asquith Ltd.

(*Stand No.* 13—*National Hall and Stand No.* 165—*National Hall Gallery*)

Some established design and some newly designed machines will be displayed by William Asquith Limited, Highroad Well Works, Halifax, on the stand of Drummond Asquith Ltd. Not surprisingly, in these exhibits the chief emphasis will be laid on radial drilling machines. Models of these ranging from one of 3 ft 2 in radius to a newly-designed heavy duty 10 ft radius machine will be shown. This heavy duty machine, the O.D.4, incorporates 18 spindle speeds ranging from 14 to 1,100 r.p.m. and nine spindle speeds from 0·002 in to 0·040 in per spindle revolution. Provision is also made for tap leads, by means of slip gears, from 6 to 40 threads per inch. A 15 h.p. motor mounted on the spindle slide provides the drive, and power radiusing motion is available to the arm. The drilling capacity is 3½ in from the solid in steel.

Another model of new design is the 3 ft 6 in elevating arm light duty radial with a drilling capacity of 1½ in from the solid in steel. This machine has 12 spindle speeds ranging



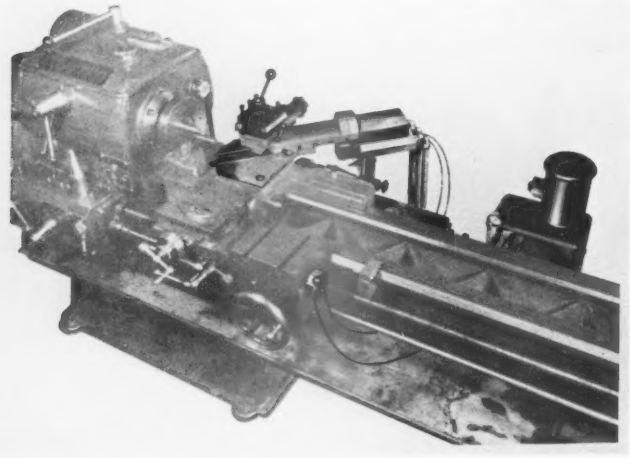
3 ft 6 in radial arm drilling machine
(*William Asquith Ltd.*)

from 60 to 2,500 r.p.m. It has four spindle speeds from 0·0055 in to 0·030 in per spindle revolution. Of the other Asquith drilling machines that will be exhibited, attention must be drawn to a vertical drilling machine with a capacity of 3 in diameter in steel. It has an electronically-controlled spacing table, the functioning of which will be demonstrated.

Attention may also be drawn to a milling machine arranged for machining drum and face cams. This machine is provided with electronically variable feeds to the longitudinal and transverse motions of the table. The maximum feed rate in both directions is approximately 5 in per minute. The maximum sizes of cams that can be accommodated are drum-type 7 in diameter × 9 in long and face-type 5 in radius.

A continuous rotary milling machine with vertical spindles will also be shown. It is particularly suitable for machining automobile crankcases and gearboxes. The machine is designed for continuous duty and will remove 72 cubic inches of cast iron per minute. Two groups of spindles are provided, each containing two roughing and one finishing spindle. These spindles are mounted in an overhead bridge piece, underneath which is a 9 ft diameter rotary table with power feed. To facilitate setting up, quick power traverse motion is available for the table. Each spindle is driven by its own 10 h.p. motor through vee-ropes, slip gears and a final worm and wheel. All controls are electrical and a complete system of interlocking protects the machine and the operator.

Finally, William Asquith Limited will show a seven-spindle horizontal boring and milling machine. This machine has 6 ft 6 in vertical traverse of the spindle, while the horizontal traverse of the column on the bed is 5 ft 3 in. The maximum capacities for the various functions of the machine are: boring 4 ft 6 in diameter; facing 5 ft 6in diameter; milling cutter 15 in diameter; drilling 4½ in diameter in steel. There are 27 spindle speeds in the range 1·4 to 150 r.p.m. For boring there are 16 feeds from 0·008 in to 3·125 in per revolution at all speeds. There is also a range of nine vertical and horizontal mechanical milling feeds, and in addition to, and independent of, these there is a range of electronically-controlled milling feeds, infinitely variable from 0·5 in to 50 in per minute.



"Copyrite" hydraulic copying attachment
(*S. N. Bridges & Co. Ltd.*)

E. W. Bliss (England) Ltd.

(*Stand No.* 56—*Grand Hall Annexe*)

From their wide range of presses, E. W. Bliss (England) Ltd., City Road, Derby, have chosen to show one high production press and one inclinable power press. The high production presses were developed to meet the demand for press equipment suitable for producing large quantities of stampings that need only comparatively short strokes. These presses have a four-piece tie rod frame, with the crankshaft supported up to the crankpin in a heavy crown, to reduce vibration and deflection to a minimum. The press to be exhibited has a maximum capacity of 45 tons, and normally operates at from 100 to 300 strokes per minute, according to the type of work and whether the press is single geared or of the flywheel type.

From a range of 13 standard sizes, with a maximum capacity of 115 tons, an inclinable power press of 55 tons capacity will be shown. This type of press is suitable for a very wide variety of operations, including blanking, piercing, forming, stamping and shallow drawing.

S. N. Bridges & Co. Ltd.

(*Stand No.* 4—*National Hall*)

So far as the automobile industry is concerned, the most interesting exhibit of S. N. Bridges and Co. Ltd., Bridges Place, Parsons Green Lane, London, S.W.6, will certainly be the "Copyrite" hydraulic copying equipment. It will be demonstrated on a Mitchell 8½ in centre "NM8" lathe and on a Swift 8½ in centre, type "S" lathe. The claim made for the "Copyrite" device is that it will do the same work as standard copy turning lathes at about one-tenth of the capital cost. Use of this attachment does not in any way change the character of the machine tool to which it is applied. It simply makes a standard machine into one that is suitable for copying internal or external contours, without affecting the machine's utility for normal boring, turning and screwcutting operations.

Bridges copying equipment for milling machines will also be demonstrated. It will be shown in use on a Victoria V.1 machine that is tooled for producing moulds for gas turbine blades. There will also be a display of the company's micro-precision drilling equipment. This will include the smallest, commercially manufactured, drill in the world, which is only 0·0020 in diameter.

David Brown Machine Tools Ltd.

(*Stand No.* 81—*Grand Hall*)

Five hobbing machines, ranging in capacity from 15 in to 60 in, and a gear shaving machine that will accommodate gears up to 25 in diameter, will be exhibited by David Brown Machine Tools Ltd., Britannia Works, Sherborne Street, Manchester 3. One of the hobbing machines is of entirely new design and has never before been exhibited. It is a versatile spline hobbing machine, model MT-V, that is a logical development of

the company's existing MT.15 hobber. This machine, although primarily designed for cutting spline shafts up to 35 in length, is also capable of hobbing spur and helical gears up to 15 in diameter. In contra-distinction to normal practice, the splines are cut in the vertical position This unusual arrangement is made possible by the mounting of a tall, rigid, upright section to receive and hold the work.

Other David Brown hobbing machines to be shown are the latest designs of the standard and universal MT.15, the MT.30 universal and the MT.60. Both MT.15 machines, the smallest in the makers' range, will generate spur and helical gears from 5 in to 15 in diameter and 10 in face-width. In addition, the universal machine will also generate worm wheels by the tangential method. They can both be used for cutting splines of moderate length. The most notable changes in the designs of these machines are the addition of an overarm for the work steady bracket, and a redesigned hob slide that gives greater strength and allows the use of larger hobs.

The MT.30 machine is fitted with a universal hob slide that combines the features of the standard slide with a tangential motion for true generation of worm wheels by taper hobs or cutters. An MT.60 is the largest hobbing machine that will be shown by this organization. It will hob spur, helical, spiral and worm gears up to 60 in diameter and 22 in face-width. It is available with either a standard or traversing hob slide, and is so designed that conventional or climb hobbing can both be carried out without adjustment.

David Brown practice for gear shaving machines will be exemplified by the S.25 machine, which is designed for the rapid shaving of spur and single helical gears by the radial loading method. It incorporates a patent, automatic crowning and chamfering device. This unit is part of the cutter assembly, and comprises a hinged slide by means of which the cutter is fed radially into mesh with the work gear during its traverse across the gear teeth.

Buck & Hickman Ltd.

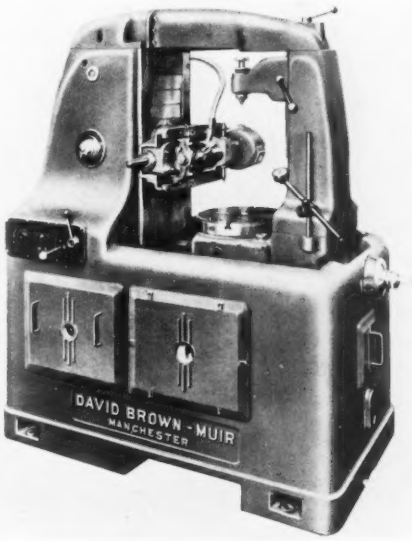
(Stand No. 76—Grand Hall)

Every engineer interested in the production of spiral and zerol bevel and hypoid gears should visit the stand of Buck and Hickman Ltd., 2-6, Whitechapel Road, London, E.1, where several Gleason machines for these classes of work will be on display. In addition to a Gleason hypoid grinder and a new design of quenching press, the exhibits will also include a Gleason No. 8 dual Revacycle completing machine for the fast production of straight bevel gears. This is a tandem set-up that has been developed for the larger types of differential pinions such as as used in trucks, where the depth of tooth is too large for finishing in one operation. The component is roughed on one machine and is then automatically transferred to the second machine for finishing.

Many other high class American machine tools will also be exhibited by this firm. One is the Pratt and Whitney No. 4E jig borer. It is of the vertical type and is capable of locating, boring and checking precision work of heavy weight to 0·0002 in accuracy. The machine has a table surface 36 in × 72 in and will accommodate work up to 5,000 lb weight. Another interesting exhibit will be the Bullard "Man-au-Trol" vertical turret lathe. This is an automatic machine on which 39 functions can be performed without cams or similar wearing parts, and with full automatic control. It can be converted to manual operation without disturbing the operating cycle.

Three Bryant internal grinders will also be shown. One is for single piece grinding of large parts up to 60 in diameter. It has a 60 in faceplate with six movable jaws that allow large irregular pieces to be chucked securely. At the other extreme is another Bryant internal grinder which can have a high-frequency wheelhead that will allow bores as small as 0·040 in to be ground accurately.

The Brown and Sharpe machines to be shown by Buck and Hickman Limited include an Omniversal milling machine designed particularly for tool-room and experimental work. It incorporates means for obtaining both simple and compound angular settings in the horizontal and vertical plane. On this machine, work may often be milled on a number of faces, or drilled or bored at different angles without the use of special fixtures.



M.T.15 universal hobbing machine
(David Brown Machine Tools Ltd.)

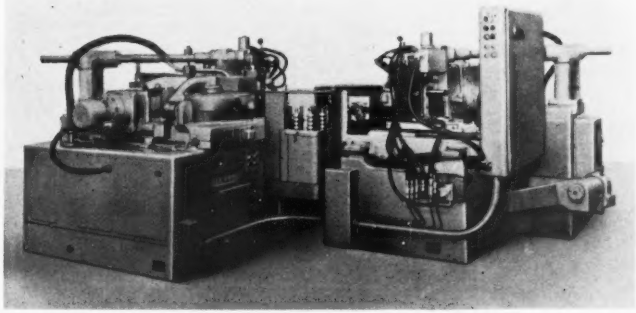
Burton Griffiths, & Co. Ltd.

(Stand Nos. 77 and 78—Grand Hall)

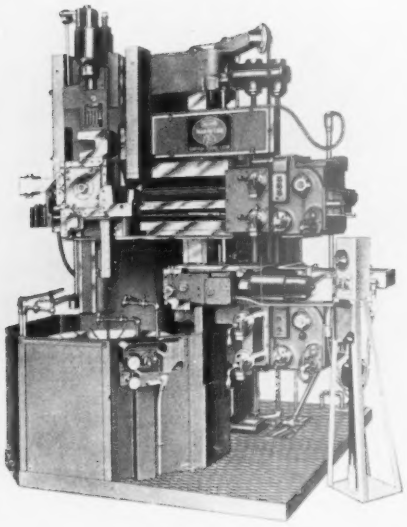
There is no doubt that the exhibits arranged by Burton, Griffiths and Co. Ltd., Mackadown Lane, Marston Green, Birmingham, will be among the most interesting in the whole exhibition. On this company's stand there will not only be British machine tools produced by The B.S.A. Tools Group, but also American, Swiss and German machines.

An interesting range of British single spindle automatic screw machines will be shown. For example, there will be two such machines manufactured by the Index Automatic Machine Co. Ltd. One is for the high speed production of components up to a maximum diameter of $\frac{1}{2}$ in in steel or $\frac{5}{8}$ in in brass or aluminium. This machine is fitted with swinging tool equipment that permits a very fast sequence of operations. It has ten work speeds from 750 to 6,000 r.p.m. The second Index machine is for components up to $1\frac{13}{32}$ in diameter. It has a six-position turret, two cross slides and one vertical slide. There are two ranges of spindle speeds, one, for turning, from 60 to 1,500 r.p.m.; the other, for reaming and threading, from 30 to 750 r.p.m.

There will also be four single spindle automatic screw machines designed and manufactured by B.S.A. Tools Ltd. Of these, the No. 48 and the No. 68 are respectively suitable for work up to $\frac{1}{2}$ in and $\frac{1}{4}$ in diameter. Both machines have a wide range of spindle speeds, 200 to 6,000 r.p.m. for the No. 48 and 53 to 4,480 for the No. 68. They also have automatic speed reductions for threading. For larger diameter work there will be two B.S.A.



Gleason dual Revacycle
(Buck & Hickman Ltd.)



Bullard Man-au-trol turret lathe
(Buck & Hickman Ltd.)

"L" type automatic screw machines. These are a recent development. The particular feature of the design is the large open front, which is possible because the entire front camshaft is in the headstock side of the cross slide. A wide range of attachments has been specially designed for use with these machines.

Modern practice in single spindle automatic chucking machines will be exemplified by two machines manufactured by B.S.A. Tools Ltd. They are designed on similar principles, but one has a capacity up to 5 in diameter and the other up to 9 in diameter. Independent motors for the spindle drive and the slide motions reduce controlling equipment and the wear on shafts and bearings. Air chucking is used on both machines. Because setting up is simple, these machines are suitable for relatively small batches as well as for large quantities.

Three B.S.A. Acme-Gridley six-spindle bar automatics and one B.S.A. Acme-Gridley chucking automatic will also be shown. All these machines have been designed to give ready access to the tools to facilitate adjustments and change-over. Each machine has a wide range of spindle speeds so that the optimum speed can be selected for any size of bar stock within the machine's capacity and for different materials. There are many attachments to increase the scope of work that can be carried out on these machines.

Swiss machine tools will be represented on the Burton, Griffiths stands by products of the Maag Gear Wheel Company Ltd. The latest type of Maag gear cutting machine for producing involute teeth of spur and helical gears will be exhibited. A device for cutting internal straight and helical teeth and racks can be supplied with this machine. The heavy duty that many gears must perform calls for both a very high standard of accuracy and a controlled degree of surface finish. For the precision production of bevel gears, a grinding machine has recently been added to the Maag range, and will be shown at the exhibition. It is for grinding the involute tooth flanks and tooth gullets of straight-toothed bevel gears. Two Maag gear testing machines will also be shown.

The exhibits of this company will include a wide range of German machine tools. It is not possible to make individual mention of these machines, but attention may be drawn to the Deckel universal pantograph die-sinking machine and to the Heyligenstaedt automatic copy milling machine. The Deckel machine gives two and three-dimensional duplication at a 1:1 ratio as well as reducing or enlarging work. It can also be used for milling operations of a general nature. The automatic copy milling machine is primarily intended for the economical production by the copying method of tools for press work. It has a fully automatic tracer that follows the contours of a template or pattern.

Butler Machine Tool Co. Ltd.

(Stand No. 52—Grand Hall Annexe)

A range of planing, shaping and slotting machines will be exhibited by The Butler Machine Tool Co. Ltd., Mile Thorn, Halifax. One, a 26 in shaper, is a prototype; the others are established designs which incorporate new features. The Butler range of planers will be represented by a double-housing spiral electric, a hydraulic openside and an openside crank planer. Each of these types has its own field of application, but the most advanced in design is the spiral electric machine which has recently been redesigned.

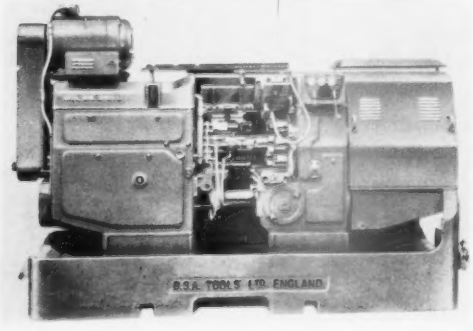
The 12 ft × 5 ft × 4 ft 6 in spiral electric planer that is to be exhibited has two tool boxes on the cross-slide and a side tool box on each upright. This machine has a patent forced-field 45 h.p. reversing motor for the main drive, with auxiliary electrical gear comprising a 4 h.p. variable speed feed motor, a 2 h.p. cross-slide elevating motor, ½ h.p. cross-slide locking motor and ½ h.p. pump motor. It also incorporates a patent feed and power traverse unit, solenoid relieving motions for all tool boxes, and electric cross-slide locking device, and electric tachometer equipment for registering the table speeds, which range from 20 to 200 ft per minute for cutting and 110 to 220 ft per minute for return.

Of the several shaping machines to be shown, attention may be drawn to the new 26 in super shaper. This is a prototype. It has a table top 26 in × 22 in. with a horizontal table travel of 30 in and a vertical travel of 14 in. The drive is taken from a 10 h.p. constant speed motor through a friction clutch to an eight speed gearbox which gives a range of 9 to 100 cycles per minute. The stroke wheel is of the single helical type, and the stroke link has the Butler patent trunnion mounting to give maximum cutting efficiency. Alteration of the stroke and the position of the ram can be effected with the machine in motion or at rest. Feeds are obtained through a patented cam mechanism that permits adjustment at any time. A single lever selects feed or power traverse to the table.

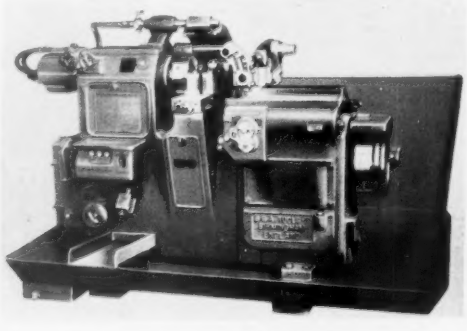
Central Tool & Equipment Co. Ltd.

(Stand No. 110A—Empire Hall)

Among their other exhibits, The Central Tool and Equipment Co. Ltd.,



B.S.A. 6-spindle chucking automatic



B.S.A. single spindle chucking automatic

(Burton, Griffiths & Co. Ltd.)

Mayland Avenue, Hemel Hempstead, Herts., will show an extremely interesting production type miller, the "Centec" 3. The main drive for this machine is supplied by direct current motor that is fed and controlled electronically from a three-phase A.C. supply. Spindle speeds, which are controlled by a simple dial that operates a rheostat, are infinitely variable from 100 to 2,800 r.p.m. The rheostat controls the speeds in two overlapping ranges, 100 to 550 and 500 to 2,800. Change from one range to the other is effected through a gear change lever at the back of the machine. Over part of the speed range, the spindle horse power is constant; over the remainder it is proportional to the speed. There is, however, ample power at all speeds. Spindle rotation can be timed to be interrupted at any part of the cycle. The table traverse is hydraulically actuated to give an infinitely variable range. A special circuit is employed to give fast approach, feed rate, and fast return. If two fixtures are employed, this cycle can be repeated during one stroke. The circuit is such that the feed is always independent of the load so that there is no backlash.

This company will also be showing a high-precision, screw-cutting, long-turning and profile-forming automatic lathe, the "Omlor 70," manufactured by Automatenbau Oskar Omlor G.m.b.h., St. Ingbert-Saar. This is a small machine that takes a maximum diameter of 7·0 mm with a maximum turning length of 70 mm. It carries four cutting tools arranged on a fixed guide assembly, and working by swivel action in immediate proximity to the work stock guide bush. A notable degree of precision is claimed.

Charles Churchill & Co. Ltd.

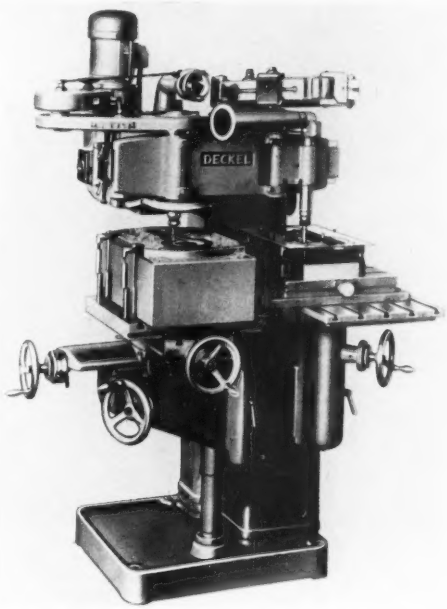
(Stand No. 99—Grand Hall)

A most interesting selection of high production machines will be exhibited by Charles Churchill and Co. Ltd., Coventry Road, South Yardley, Birmingham, 25. The machines to be shown comprise a Conomatic 6-spindle automatic bar machine, a Goss and DeLeuw "one-two-three" 7-spindle tool rotating automatic chucking machine, four Petermann single-spindle automatic bar machines, two Timbrell and Wright high production capstan lathes and a Vertimax lathe, and two Churchill-Fay automatic lathes.

Of the multi-spindle automatics it must suffice to say that they are representative of the latest American practice. For example, the Conomatic machine has an exceptionally long tooling area that simplifies tool setting, and also allows more tools to be accommodated so that more machining operations can be performed at one setting. There is also a wide range of special attachments for use with this machine.

S. A. Jos. Petermann, Moutier, Switzerland, were pioneers in the development of precision single automatic machines for small diameter work. The four machines to be shown will have capacities of 4 mm, 7 mm, 16 mm and 25 mm. The 16 mm machine is of new design and will be shown for the first time in this country. In principle these machines are of similar design with the tools situated round the axis of the machine, and moving perpendicularly to the axis of the bar. The rotation and feed of the bar are controlled by the headstock. Apart from the high degree of precision that may be obtained from these machines, their outstanding feature is the very wide range of operations that can be carried out at a single setting through the use of specially designed attachments.

One of the Timbrell and Wright high production capstan lathes will be equipped for bar work and the other for chucking work. They embody a number of new features. For example, there is a new automatic bar feed, which incorporates means for instantaneous adjustment of the feed pressure to compensate for diminishing bar weight as the stock is fed through the machine. Another useful feature is that starting, stopping and reversing are foot-controlled, and the operator's hands are free for other duties.

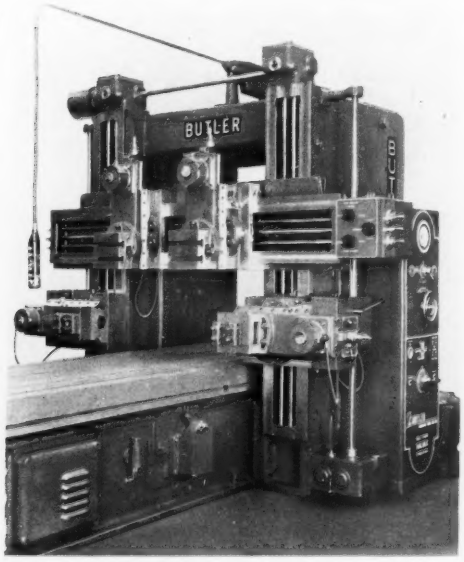


Deckel universal pantograph die-sinking machine
(Burton, Griffiths & Co., Ltd.)

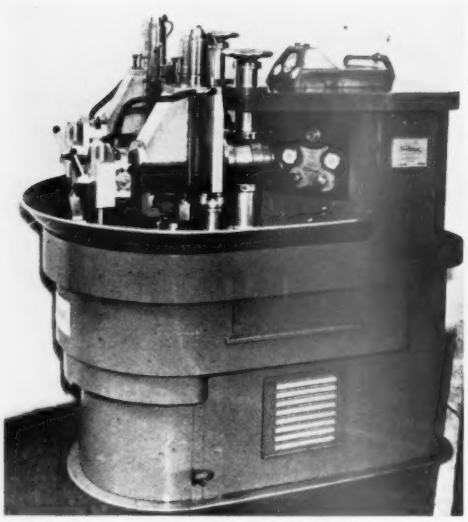
The Vertimax production lathe departs from conventional practice as regards system of construction and general layout. It is a vertical chucking lathe with twin slides. The feed is hydraulic, and the slides and hydraulic cylinders form units that can be swivelled through more than 120 deg from below the horizontal to beyond the vertical positions. This makes possible, in addition to normal turning, the simultaneous machining of two internal or two external tapers, or of an internal and an external taper.

This machine is primarily meant for repetition work, but it is so easily set-up that it can be used economically for small batches. The slides, in addition to being designed for swivelling, have an eccentric mounting. The arms carrying the slides can be moved both radially and horizontally, thus facilitating the setting of the tools in relation to the workpiece. A differential system is used for the hydraulic tool slide feed. As it is "hydraulically locked," it is ideal for interrupted cutting.

A Churchill-Fay 12 in × 33 in multi-tool automatic lathe will demonstrate high speed turning; an 8 in × 22 in machine will also be shown. These machines are too well known to call for detailed descriptions. Attention may, however, be drawn to one or two features. The carriage tooling can be arranged to turn straight and taper diameters simultaneously, and with the available combination of tool movements, any piece within the capacity of



Spiral electric planer
(Butler Machine Tool Co. Ltd.)



Vertimax production lathe
(*Charles Churchill & Co. Ltd.*)

the machine can be tooled up for production with the shortest possible tool travel. Automatic tool relief is another important point on these machines. It allows the turning tools to be relieved at any point during the cycle. Thus, when a straight shaft is being turned by multiple tools, it is possible to fade out the tool pressure when the cuts start to overlap. Because of this, two or more tools can be used on one straight diameter, with a consequent reduction in tool travel and machining cycle. It also eliminates any scoring of the work during the return stroke.

The Churchill Machine Tool Co. Ltd.
(*Stand No.* 68—*Grand Hall*)

There is no doubt that for those concerned with precision grinding, the exhibits of The Churchill Machine Tool Co. Ltd., Broadheath, near Manchester, will be of compelling interest. Apart from the many design features for giving continued accuracy with high production rates, which are peculiar to Churchill grinders, there is added interest because of the very wide range of machines that will be displayed. No matter what the precision grinding application, there is a Churchill machine that is suitable, and the nine machines that are to be shown will give some idea of the range available. There will be four plain grinders, the smallest 4 in × 12 in and the largest 36 in × 168 in; one fully automatic centreless grinder; one universal grinder; two automatic sizing internal grinders; and one slideway grinding machine. Several of these machines are of new design to be exhibited for the first time.

One of the machines to be shown for the first time is the model "OW" 4 in × 12 in "Fulcro-sizer" fully-automatic plain grinder. It has been specifically designed for grinding to extremely close limits external diameters of small components such as those required for scientific instruments and fuel injection equipment. The maximum grinding capacity is 4 in diameter and 12 in between centres. A grinding wheel of 14 in diameter is used. This is a considerably larger wheel than is normally used on machines of this capacity.

The workhead is of the dead centre type. There are three work speeds, 294, 591 and 898 r.p.m. A hydraulically-controlled tailstock is fitted. The barrel carrying the work centre is rack propelled forward under the action of a compression spring and is withdrawn through the medium of a hydraulic piston. The cylinder carrying the hydraulic piston is interconnected with the hydraulic cylinder that operates the "Fulcro - sizer" motion of the table. With the "Fulcro-sizer," which operates on a fully-automatic cycle, the work is fed to the grinding wheel, and automatic sizing to plus and minus 0·00005 in is possible on long runs of components. A fuller description of this machine, which incorporates many novel design features, will be published in a subsequent issue of this journal.

A model "EC" No. 2 centreless grinder will be exhibited as a fully automatic machine with hopper feed. The control wheel slide of this machine is roller mounted for sensitivity, and in addition to the normal screw adjustment controlled by a large handwheel, it is fitted with a hydraulic quick and fine feed movement. In operation the control wheel slide is advanced at a fast speed almost to the grinding position; then there is a slow forward feed to the size position. The maximum quick hydraulic movement is 1·000 in, while the grinding feed is infinitely adjustable up to 0·0625 in according to the amount of metal to be removed.

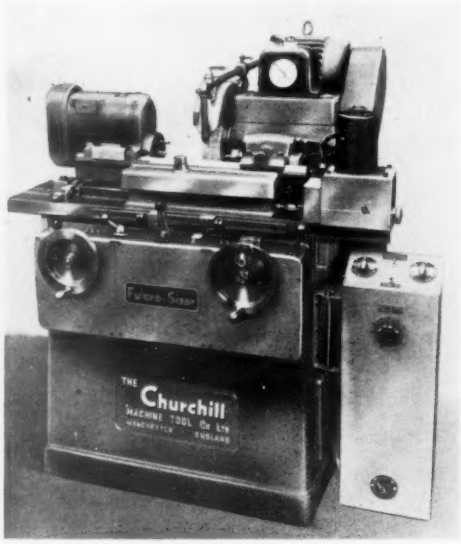
At the maximum forward position an adjustable electrical dwell comes into operation. After a suitable dwell period to control the finish, the control head returns quickly to the unloading position. Almost simultaneously with the run-back movement, an air-operated ejector mechanism comes into action to eject the ground component from the grinding fixture or guide. As the slide is returning to the backward position a small spring-loaded delay valve comes into action to allow ample time for work ejection and reloading before contact is made with the cycle starting switch. A rotary motor-driven hopper, operating in conjunction with the automatic ejection mechanism, is incorporated in the design.

Two "HBG" automatic sizing internal grinding machines will also be shown. One will be set up for grinding short bores by the plunge method, and the other will be shown grinding long bores by the traverse method. This machine merits a much fuller description than can be given here. It must suffice to say that it incorporates features which ensure accurate sizing, and it differs from the "HBA" and "HBB" series in that the workhead moves transversely across the body to provide the necessary feed to the work, while the grinding wheel spindle traverses into the bore on a fixed path. If a sliding jaw type of chuck is used, the maximum diameter and length of hole are 6 in and 2½ in respectively.

Churchill-Redman Ltd.
(*Stand No.* 101—*Empire Hall*)

Among the machines to be displayed by Churchill-Redman Ltd., Parkinson Lane, Halifax, Yorks., will be sliding, surfacing and screw-cutting lathes, a semi-automatic hydraulic profiling lathe and Churchill-Cleveland gear production machines. The semi - automatic profiling lathe is hydraulically controlled throughout. It has been designed primarily for the production of profiled components by semi-skilled operators. The profiles are obtained automatically by using a completed component or plate template as a master.

There is a 6 in swing over the saddle, and the machine will admit 40 in between centres and the maximum length that can be turned is 36 in. The tool slide has controlled movement at 45 deg, and the cutting tool can be independently positioned and adjusted on a micrometer slide



"OW" Fulcro-sizer grinding machine
(*Churchill Machine Tool Co. Ltd.*)

provided with multiple positive sizing stops. The headstock has a minimum of gears, only a three speed change being provided. Other speed ranges are obtained by pick-off gears. On the three speed change, the gearing is selected to give two low speeds for rough turning and one high speed for finishing. If a two-speed motor is used, 24 spindle speeds in the range 130 to 1,000 r.p.m. can be obtained by using the four pick-off gears supplied with the machine. With a two-speed motor, a 2:1 ratio automatic spindle speed shift is provided for increasing or decreasing spindle speed automatically at any position of the tool carriage. The carriage feed rate is infinitely variable from zero to 17 in per minute.

Cincinnati Milling Machines Ltd.

(Stand No. 74—Grand Hall)

In the past few years there have been spectacular advances in milling machine practice. Feed rates and rates of stock removal that a short time ago would have been considered fantastic are now employed with every success, and what is more, they are allied with close dimensional accuracy and a high degree of surface finish. The products of Cincinnati Milling Machines Ltd., Woodlands Farm Road, Tyburn, Birmingham, 24, have played a leading part in these developments. Naturally, this organization will exhibit several milling machines, but there will also be profiling and die-sinking machines, a broaching machine and two cutter sharpening machines.

The milling machines will comprise four tool room and general purpose millers and four production millers. One of the tool room machines, the No. 3 universal high speed dial type will be shown set up to demonstrate typical tool room operations with various types of cutters. It will also be set up to illustrate the boring of spaced holes, for which purpose it will be equipped with a universal overarm attachment and precision measuring equipment. The universal overarm attachment permits a greater range of operations to be carried out at a single setting on the machine table. Normally, this type of machine is supplied with a standard dividing head, but the one to be shown will have a wide range divider that gives all divisions of the circle up to 400,000.

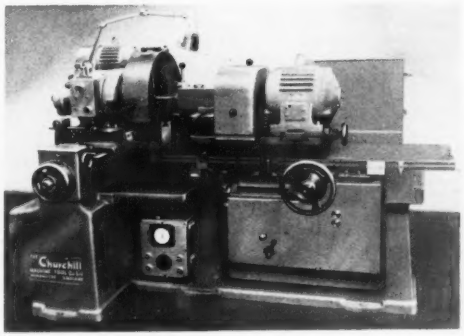
A No. 5 dual power machine will be exhibited for the first time in this country. It is a robust knee and column machine specifically designed for taking exceptionally heavy cuts on large components. Attention may be drawn to the square gibbing and the yard-wide knee. The full 50 h.p. of the motor is supplied to the spindle at high speeds, but is automatically reduced to half for the six lowest speeds. The machine will be set up on an automatic table cycle for slot milling with tungsten carbide tipped cutters.

One of the features of Cincinnati Hydromatic milling machines is their unit construction, which permits variable factors to be grouped over a wide range. Standard, semi-standard and special purpose machines all incorporate standard units. One of the production machines will be a 34-36 plain Hydromatic, itself a hybrid with a No. 3 spindle carrier and a No. 4 bed table. It will be shown with a two-spindle automatic indexing fixture for brake pressure plates.

A plain tracer-controlled Hydromatic will also be shown. On this machine a sensitive tracer controls the movement of the spindle carrier in such a manner that the vertical movements of the spindle carrier are synchronized with the longitudinal travel of the table to allow profile shapes to be reproduced from master templates. All tracer controlled Hydromatics are arranged for completely automatic table cycles, but they can also be used for conventional milling operations.

Machines developed for a specific application will be represented by a special duplex four-spindle ram-type Hydromatic. It is for milling both ends of a cylinder block at one setting. A feed rate of 50 in per minute is employed with a depth of cut of $\frac{1}{8}$ in for the roughing cutters and $\frac{1}{50}$ in for the finishing cutters.

Only brief reference may be made to the other Cincinnati exhibits. For profiling and die-sinking they will show two tool and die millers and a vertical Hydrotel. Of the tool and die millers, one will be set up for sinking a typical stamping die and the other for reproducing a decorative plaque. On the latter machine there will be a duplex rotary attachment which carries the master on one table and the work on the other. With this set-up, instead of the orthodox longitudinal scanning, the twin tables rotate while the saddle is automatically fed across the knee to give automatic scanning of the circular workpiece. The Hydro-tel machine will be shown fitted with automatic depth control and 360 deg selective automatic profiling attachment. The first provides sensitive automatic tracing in the vertical plane, and the second gives the added facility of profiling from master templates in a horizontal plane. Inclusion of an automatic cycle attachment allows full-form impression to be machined without the constant attention of the operator.



H.B.G. automatic grinder
(Churchill Machine Tool Co. Ltd.)

Clifton & Baird Ltd.

(Stand No. 22—National Hall)

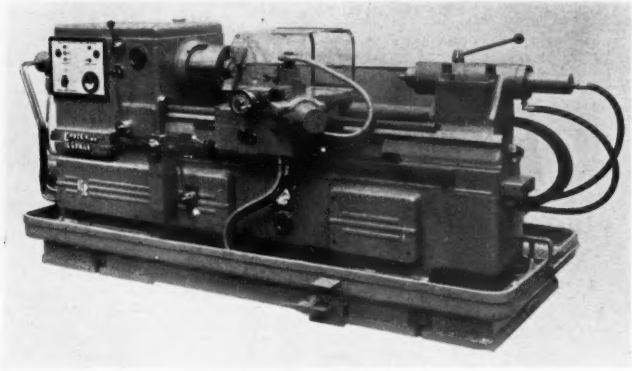
Cold metal sawing machines and an automatic circular saw sharpening machine will be exhibited by Clifton and Baird Ltd., Empress Works, Johnstone, near Glasgow. One of the machines to be shown is the smallest of a new range of cold metal sawing machines that accommodate high production segmental saw blades from 14 in to 72 in diameter. This machine will take blades of from 14 in to 18 in diameter, and when an 18 in diameter blade is fitted the maximum capacity on solid sections is $5\frac{1}{4}$ in diameter and $5\frac{1}{4}$ in square. There are three cutting speeds, providing 30, 44 and 66 ft per minute peripheral speed. This speed range makes the machine suitable for cutting all classes of steel.

George Cohen Sons & Co. Ltd.

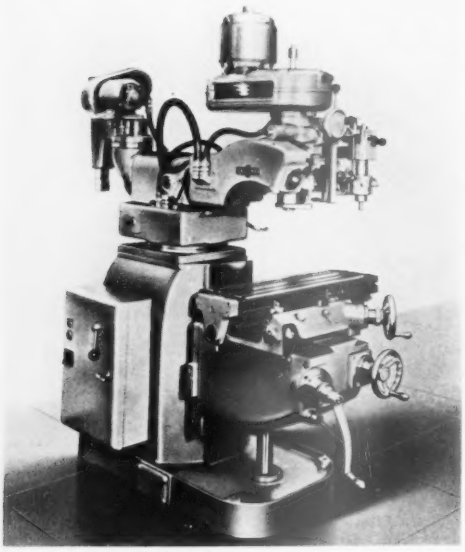
(Stand No. 48—Grand Hall)

Continental machines of several types will be exhibited by George Cohen Sons and Co. Ltd., Sunbeam Road, London, N.W.10. Perhaps the most interesting of the machines to be shown by this company will be four Mondiale lathes, which may be regarded as typifying the best of the Belgian machine tool industry. Of the Mondiale lathes we may draw particular attention to the "Selectronic."

This machine combines the advantages of infinitely variable speed with those of pre-selection and remote electro-mechanical control. It is intended specifically for high speed production of small and medium work. There are three available speed ranges; 400 to 3,200, 250 to 2.000 and 125 to 1,000 r.p.m., six longitudinal feeds from 0·002 to 0·024 in, and six transverse feeds from 0·001 to 0·012 in.



12 in profiling lathe
(Churchill-Redman Ltd.)



Tool and die miller
(*Cincinnati Milling Machines Ltd.*)

Stuart Davis Ltd.

(*Stand No.* 24—*National Hall*)

Modern German practice for a wide range of machine tools will be illustrated by the exhibits of Stuart Davis Ltd., Much Park St., Coventry. These exhibits will include a relieving lathe, various grinding machines, automatic machines, broaching machines, cold headers for rivets and bolts, and automatic nut presses.

One of the most interesting exhibits will be the latest model of the Reinecker universal relieving lathe. This machine is designed for relieving thread and gear hobs with straight or spiral flutes, and all kinds of milling cutters with radial, angular or axial relief, turned or ground. An improved transmission has been incorporated in this machine to ensure complete independence for the three groups of change gears. This considerably simplifies operation of the machine.

Various Reinecker grinding machines will also be exhibited. One is a recent design of tool grinder for grinding the front edge and land of all kinds of cutting tools. It has a new design of tilting table that makes possible the grinding of conical tools and the lead of taps without the necessity for using additional devices. An automatic spiral grinding device for generating spiral flute milling cutters can be supplied. It is hoped also that a new Reinecker internal and face grinding machine will be available. This is a machine designed specifically for grinding the bore and face of a component at one setting, thus ensuring that the bore is true with the locating face.

Universal dial-type milling machine
(*Cincinnati Milling Machines Ltd.*)

Dean Smith & Grace Ltd.

(*Stand No.* 45—*Grand Hall*)

Since 1865 Dean Smith and Grace Ltd., Keighley, Yorks., have specialized in the design and manufacture of high quality lathes, and throughout the whole period there has been consistent development that has maintained the reputation of their product as among the best of its kind. For this exhibition they have chosen to demonstrate their present products by showing five centre lathes, one precision tool room lathe and one surfacing and boring lathe. Certain features are common to all these machines. For example, each one will be fitted with a new totally-enclosed dial change feed box, will have a three bearing spindle which gives a very rigid mounting and ensures minimum deflection under load, and will have a patent "fast-lock" spindle nose for quickly and accurately securing chucks and faceplates to the spindle.

The centre lathes to be shown are all designed on the same principles. They vary in swing diameter from 13 in to 26 in. Each has a wide range of spindle speeds and feeds. The 26 in diameter swing machine differs from the others in having electrical quick power traverse to the saddle. This organization's products for tool room work will be exemplified by a 17 in swing, motor-driven precision lathe, which will take 48 in between centres. It has 36 forward spindle speeds from 3·9 to 720 r.p.m. and 12 reverse spindle speeds from 6·9 to 720 r.p.m. There are also 48 sliding and 48 surfacing feeds. This machine can also be used for screw-cutting, relieving and taper turning.

Drummond Bros. Ltd.

(*Stand No.* 12—*National Hall*)

Maxicut multi-tool lathes and gear shapers will be shown by Drummond Brothers Ltd., Rydes Hill, Guildford, on one of the stands organized by Drummond-Asquith (Sales) Ltd., King Edward House, New Street, Birmingham, the selling agents for Drummond products. The lathes will comprise two automatic "Maximatics," one semi-automatic "Maximatic" and two automatic "Maximinors."

As the various multi-tool Maxicut lathes are already so well known and so widely used in the automobile industry, there is no necessity to give detailed descriptions of them. It will, therefore, suffice to recapitulate some of the outstanding features. Maximatic machines are built on the unit principle that makes for easy accessibility to all parts, and the general construction is such that very heavy cuts can be taken. Motions to the cross slides are controlled by flat former plates and followers, the simplest form of camming that can be employed. All the machine motions are under push button control for initial starting and stopping, and thereafter only the starting lever is used for each cycle. One of the automatic Maximatics, of a size suitable for the production of hubs, will be fitted with one front and one rear slide and an air-operated tailstock. The second one will have two front and two rear slides and a double end drive. It is a machine suitable for turning crankshaft pins.

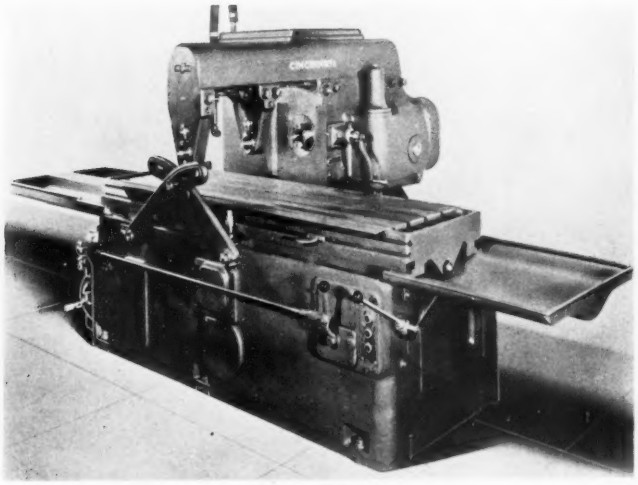
Maximinor multi-tool lathes are smaller than the Maxicut lathes but they are designed on the same general principles, and embody many of the same features. One of these machines will be shown with one front and rear slide and a third overhead slide centring attachment. This machine is suitable for work on automobile pistons. The second Maximinor will have one front and one rear slide and a hand-operated tailstock. It is suitable for general purpose multi-tool work.

Drummond practice in gear shaper design will be illustrated by two No. 3A and two No. 2A Maxicut machines. The 3A is a heavy duty machine for spur or helical gears and cam forms with a maximum capacity of 18 in P.D., 5 in face and 3 stub diametral pitch. For spur or helical gears and cam forms not exceeding 7 in P.D., 2 in face and 6 diametral pitch, there is the 2A high speed Maxicut gear shaper.

Elgar Machine Tool Co. Ltd.

(*Stand No.* 34—*Grand Hall Annexe*)

Although British and German machines will also be shown, the chief interest in the exhibits of Elgar Machine Tool Co. Ltd., Hampton Road, Hanworth, Middlesex, may well turn to the wide range of Italian machine tools. Hitherto, Italian machine tools have not been well-known here, but their qualities are beyond dis-



Plain hydromatic milling machine
(Cincinnati Milling Machines Ltd.)

pute. One of the outstanding Italian machines to be shown by this company is the Morando tool room lathe, which will be fitted with the latest design of hydraulic copying attachment which enables shoulder work of 90 deg to be carried out. A further feature of this attachment that makes it useful for short run work is that the template holder is fitted with nine stations so that nine different parts can be machined without re-setting.

Attention may also be drawn to two Mannaioni machines, a short thread miller and an automatic long screwing machine. The thread miller will machine threads up to $1\frac{3}{8}$ in long × 8 in diameter. It employs a master nut, and once the thread is cut, the spindle returns automatically to the starting position. The automatic long screwing machine will admit 28 in between centres and will screw a length of 20 in. Once set the machine is fully automatic, the leads being obtained from a leadscrew which has to be a multiple of the threads to be cut.

B. Elliott & Co. Ltd.

(Stand No. 65—Grand Hall)

In addition to machines of their own manufacture, B. Elliott and Co. Ltd., Victoria Works, Willesden, London, N.W.10, will show a representative selection from the range of machine tools manufactured by their subsidiary companies, The Victoria Machine Tool Co. Ltd. and The Cardiff Lathe and Tool Works Ltd. Many machines of new design will be exhibited. These will include milling machines, lathes and grinding machines.

One of the new machines is a "Victoria" U2R universal miller. It has separate motors for the spindle and feed drives. They are controlled from a single lever and are inter-connected to allow the spindle motor to be braked and stopped when the rapid traverses are operated. There are 12 spindle speeds from 25 to 1,200 r.p.m. They are selected by a simple arrangement with a direct reading dial and lever.

A stator rotor providing power for the feeds and rapid traverses is housed in the knee. Power traverse is provided for all directions, with 18 feed rates in each direction. These rates are 0·5-12 in/min longitudinal, 0·6-17 in/min transverse and 0·4-9 in/min vertical. The rapid traverse rates are 75 in/min longitudinal, 99 in/min transverse and 53 in/min vertical.

Another new machine is the Excel No. 3 hydraulic surface grinder. This has rapid traverses in all directions, electro-hydraulically operated cross feeds, and infinitely variable feeds to the table from 0 to 60 ft/min. The saddle carries the complete table unit. At each reversal of the table, the crossfeed can be operated by hand or electrically to give feeds from 0·004 in to $\frac{1}{2}$ in per reversal. Trip motions are provided to cut out at any predetermined position, and frictionally-mounted dials, graduated in increments of 0·001 in are fitted.

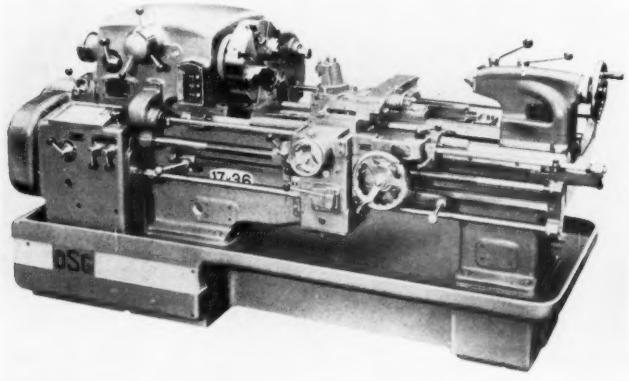
The Gear Grinding Co. Ltd.

(Stand Nos. 31-32—Grand Hall)

An Orcutt automatic spur tooth grinding machine and an Orcutt 20 in shaft grinding machine will be the chief exhibits of The Gear Grinding Co. Ltd., Cranmore Boulevard, Shirley, Birmingham. This company will also show a lead measuring machine, an involute measuring machine and Fellows Orcutt gear shaper cutters. The automatic spur tooth grinder is a machine of new design. It incorporates automatic cycle control, which reduces the work of the operator to loading, unloading and starting the cycle.

The automatic cycle control is operated electrically, with cam applied feeds at each revolution of the gear. There is a range of cams for use on this machine, to allow the depth and number of feeds applied to be varied to suit different classes of work. In practice it is found that each cam will cover a range of components. The number of wheel dressings and the stages at which they are applied are selected to suit the work being ground. To effect further improvement in the quality of the work, a new design of plain bearing has been applied to the wheel spindle and its motor drive.

If due consideration is given to the preparation of the gear teeth before hardening, grinding after hardening can be economically attractive. It is possible to produce a tooth form that calls for grinding only on the flank, and still have a smooth blend with the root form. This greatly reduces the grinding time, since if the root has to be cleared, a very slow feed must be employed. The machine will admit gears up to 24 in diameter. It can also be adapted for grinding gears and pinions between centres.



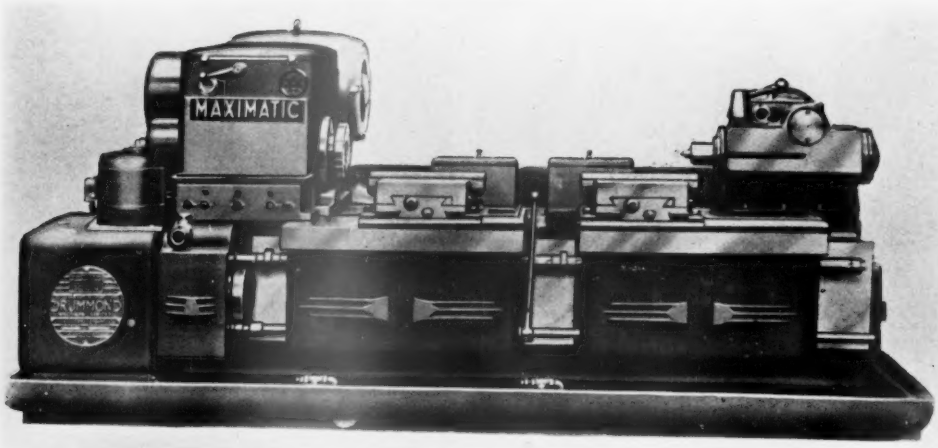
Precision tool room lathe
(Dean Smith & Grace Ltd.)

Alfred Herbert Ltd.

(Stand No. 66A—Grand Hall)

At previous International Machine Tool Exhibitions, the stands of Alfred Herbert Ltd., Edgwick, Coventry, have always been centres of attraction because of the comprehensive display of their own machines and of foreign machines for which they are the British agents. It is to be regretted that for this exhibition they have felt compelled to limit their exhibits to two machines.

One of these machines, the Herbert No. 2 Flashcap lathe will be shown in operation. This machine has been specially



Maximatic multi-tool automatic lathe
(Drummond Brothers Ltd.)

designed for high production rates on brass and other non-ferrous components with internal or external threads, or both, and requiring frequent spindle reversals at high speeds. The motor control gear provides instantaneous starting, stopping and reversal of the spindle through a fluted handwheel and knob at the front of the headstock. In addition, automatic change from forward or reverse can be effected by the movement of the capstan slide, a feature of great advantage in tapping blind holes or in threading close to a shoulder.

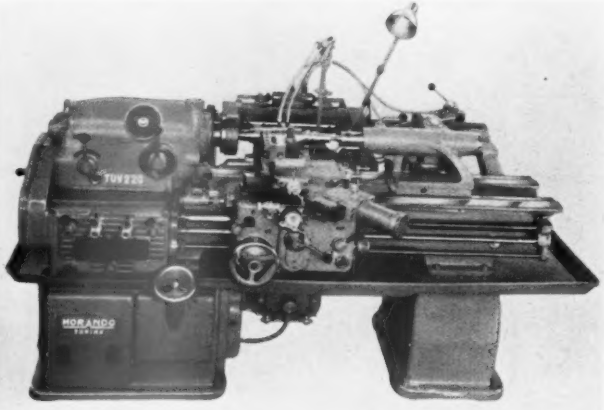
Automatic changes from forward to reverse are effected by push rods, mounted above the capstan, which actuate a spring-loaded plunger in the headstock to operate the motor switch. The push rods can be set to effect an instantaneous change of direction at any desired point in the capstan slide travel. An adaptor can be fitted to the push rods to allow two changes of spindle reversal to be obtained during one forward and return motion of the capstan slide. Thirty spindle reversals can be made per minute when the machine is fitted with a 6 in air chuck and is running at 1,240 r.p.m. Heavier chucks reduce the number of reversals per minute.

The second machine is a No. 14/36 combination turret lathe. This is the largest of the Herbert range of lathes. Its headstock is driven by a two-speed, 12½/50 h.p. motor, giving a range of 16 spindle speeds from 12 to 480 r.p.m. for turning, and five additional slow speeds from 4 to 11 r.p.m. for screwing and reaming. The saddle has 16 reversible automatic sliding and surfacing feeds, 12·4 to 482 per inch longitudinally and 13·8 to 540 transversely. Feeds are independent of the turret slide feeds. A backlash eliminator is fitted to the cross slide to allow accurate tapers to be machined independent of the direction of feed.

Holbrook Machine Tool Co. Ltd.

(Stand No. 36—Grand Hall Annexe)

For many years the toolroom lathes designed and manufactured by Holbrook Machine Tool Company Limited, 44-48, Martin Street, Stratford, London, E.15, have earned high praise for their precision, ease of operation and general suitability for high-class work. The latest lathe developed by this company will be shown at the exhibition and will undoubtedly further enhance their reputation. It is the model "A" 27-30 toolroom lathe, swinging 30 in over the bed and taking 72 in between centres.



Morando tool room lathe
(Elgar Machine Tool Co. Ltd.)

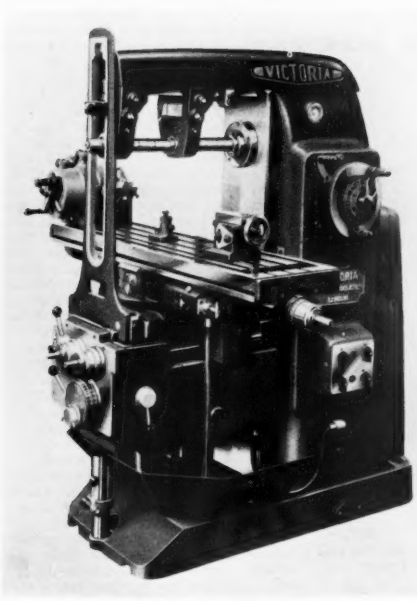
Wide ranges of speeds and feeds are provided. There are 24 spindle speeds, forward and rverse, from 3½ to 700 r.p.m. Changes are effected hydraulically. A quick change gearbox provides 80 totally enclosed direct changes obtained through a dial control. It gives a feed range of 0·0003 in to 1·50 in and from 1 to 30 t.p.i. The feedshaft has an adjustable multi-disc clutch, accessibly mounted, to prevent overloading.

In its standard form this machine is fitted with internal slide and taper turning equipment and a normal top slide with a square turret. Alternatively the carriage has neither an internal slide nor taper turning equipment but has power feed to the top slide with a clutch incorporated to allow hand setting of the tool. The machine to be shown will be in the second condition, and in addition will have Metro - Vickers electric profiling equipment. A model "R" No. 9 relieving lathe will also be shown. This machine will be set up for grinding a large hob with straight flanks. In its standard form this is a very useful machine, and the range of work for which it is suited can be greatly extended by the use of specially designed attachments. These include automatic profiling equipment, hob grinding equipment, a pencil wheel grinding head with a spindle running at 22,400 r.p.m., and a wheel truing device for dressing formed wheels.

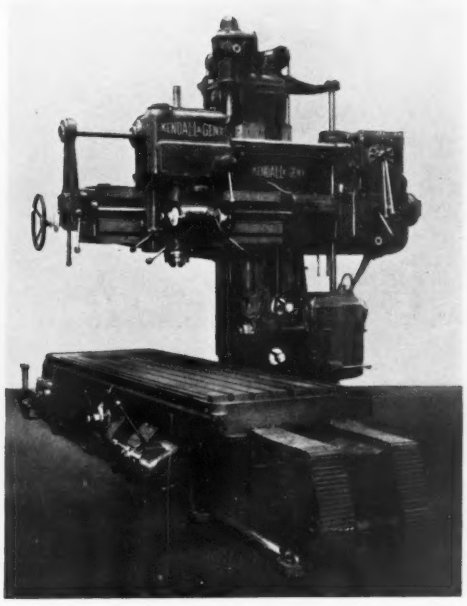
Horden Mason & Edwards Ltd.

(Stand No. 73—Grand Hall Annexe)

Geared and ungeared presses over a



Victoria U2R universal miller
(*B. Elliott & Co. Ltd.*)



Vertical and horizontal milling machine
(*Kendall & Gent Ltd.*)

fairly wide range of capacities will be shown on the stand of Hordern, Mason and Edwards Ltd., Woodlands Farm Road, Tyburn, Birmingham. The smallest is an inclinable, ungeared press with a stroke variable from $\frac{1}{8}$ in to $2\frac{1}{2}$ in. It is of 12 tons capacity and is fitted with a double roll feed for the production of work from coiled strip at high rates of output. The other ungeared press is of 40 tons capacity and is suitable for blanking, piercing and forming operations. Since this press has no tie rods, it will admit relatively large work.

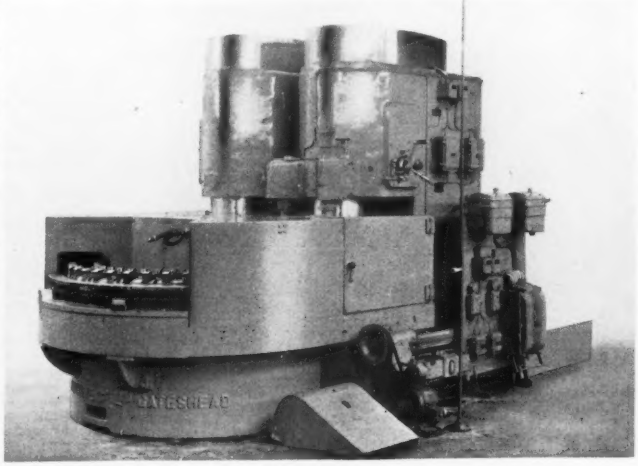
The geared presses are of greater capacity. One, a geared, double-sided crank press, has a capacity of 200 tons. It incorporates a pneumatically - balanced slide, with a top ejector and air operated foot control. A double-sided double-action, receding table drawing press will be of interest to the automobile industry. It has been specially designed for the production of drawn articles in most materials up to a depth of 10 in. The table descends clear of the pressing to facilitate extraction and re-loading. Ejection of the work is effected by the downward movement of the table.

Geo. Jackman Machine Tool Co. Ltd.

(*Stand No.* 10—*National Hall*)

In addition to a range of their established disc grinders, Geo. Jackman Machine Tool Co. Ltd., 29, Derby Road, Enfield, Middlesex, will be showing two new machines. One of these machines is the largest in the company's range. It has a 72 in diameter grinding disc and is therefore suitable for a very wide range of work. The spindle, with a large flange supporting and driving the 72 in diameter steel disc, runs on large roller bearings mounted as a unit in a rigid housing. A 25 h.p. motor supplies the drive. Normally, the grinding disc is fitted with fast, cool-cutting corrugated abrasive, $\frac{1}{2}$ in thick and available in the full range of grinding wheel gradings. It is made in four sections with simple screw fixing.

Another machine to be shown for the first time is a No. 15 double-end disc grinder. This is the largest Jackman machine of this type. It will be fitted with 30 in diameter × $1\frac{1}{2}$ in thick bolt-on grinding discs and lever feed tables.

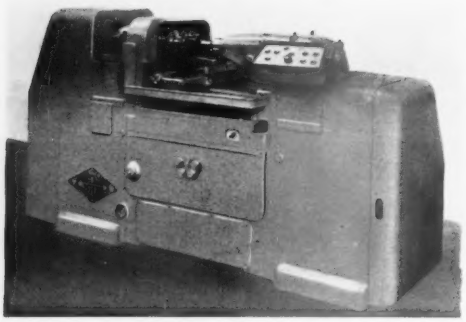


Double-spindle surface grinder
(*Lumsden Machine Co. Ltd.*)

H. W. Kearns & Co. Ltd.

(*Stand No.* 37—*Grand Hall Annexe*)

The merits of the machines manufactured by H. W. Kearns and Co. Ltd., Broadheath, near Manchester, are recognized and known throughout the automobile industry. A representative selection of the company's horizontal boring, milling and drilling machines will be shown. They will include a No. 3 patent surfacing, boring, milling, drilling and tapping machine with the latest design of all-electric drive. This machine has a $3\frac{1}{2}$ in diameter spindle and a built-in automatic



Precimax fine borer
(*John Lund Ltd.*)

facing chuck. It is suitable for medium and heavy duty operations.

They will also show a smaller high speed machine for use where surfacing operations predominate. This machine can also be used for milling and drilling, and if the tables are traversed, it can be used for boring short holes. Attention may also be drawn to the Kearns optimetric horizontal toolroom boring machine, which will be shown on *Stand No. 222—Empire Hall, First Floor.* This machine incorporates optical measuring devices for the vertical and transverse motions.

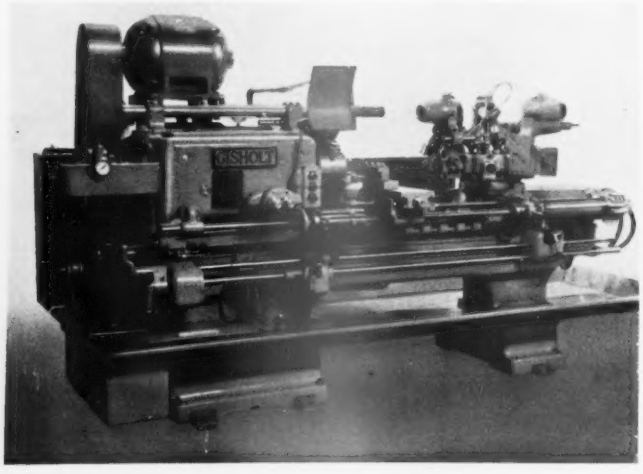
Kendall & Gent Ltd.

(*Stand No. 61—Grand Hall*)

Milling machines, screwing machines and a broaching machine will be exhibited by Kendall and Gent Ltd., Victoria Works, Gorston, Manchester, 18. One of the milling machines, a 3 in open-side vertical and horizontal model, incorporates some specially interesting features. For example, it differs from the standard model in that the change-gear boxes on the table traverse and the vertical milling head traverse have been replaced by electronic drives that give infinitely variable feeds. As the machine is fitted with one milling head on the cross-slide and one on the upright, several operations can be carried out simultaneously at one setting.

The table is driven from a D.C. motor, which can be infinitely varied for speed by means of electronic control. It gives a range of table speeds from 1·42 in to 21 in per minute. There is also constant rapid power traverse for setting purposes. The control is so arranged that potentiometers fitted to the control desk at the side of the machine provide instant feed changes, while immediately the rapid power traverse button is depressed for either direction, the potentiometer control is by-passed and the motor speeds up to give rapid table traverse. Vertical milling head feeds are obtained in a similar manner. The main driving motor and the table traverse motor are electrically interlocked so that failure of the spindle motor for any reason automatically stops the table.

Although the 3½ in spindle plano-milling machine that is to be shown is not the largest made by Kendall and Gent Ltd., it is the largest they have ever included in an exhibition. This machine is widely used by manufacturers of diesel engines. It has three independently driven milling heads, two vertical mounted on the cross-slide and one horizontal on the right-hand upright. Each milling head is powered by a 20/20 h.p. motor. There are 16 spindle speeds in the range 10 to 206 r.p.m. This range is applicable to all engineering materials and is suitable for negative rake or normal milling.



Gisholt "Fastermatic" turret lathe
(*Gaston E. Marbaix Ltd.*)

Kitchen & Wade Ltd.

(*Stand No. 35—Grand Hall Annexe*)

Because of space limitations, Kitchen and Wade Limited, Arundel Street, Halifax, Yorks., are confining their exhibits to four radial arm drilling machines. They have capacities of 1½ in, 2 in, 3 in and 3½ in respectively from the solid in mild steel. A special feature of all these machines is the centralizing of the controls within easy reach of the normal operating position.

Except on the largest machine, gear changes are actuated by a single lever control. The largest machine has a range of 36 speeds from 800 to 8½ r.p.m., and 18 in length of feed. In addition to power feeds, all the machines have fine and quick hand adjustment to the spindle. To ensure a perfect fit and minimum wear over long periods of service, both the bore for the spindle quill and the bore of the arm are finished by honing. An Ormerod high speed shaping machine and an Ormerod lotting machine will also be shown on this stand.

John Lang & Sons Ltd.

(*Stand No. 106—Empire Hall*)

Six sliding, surfacing and screw-cutting lathes and two surfacing and boring lathes will be exhibited by John Lang and Sons Ltd., Johnstone, Renfrewshire, to demonstrate their present-day production of high class machine tools. The exhibits will include a prototype 17 in swing sliding, surfacing and screw-cutting lathe with a high speed headstock. It has been developed to meet the demand for turning at the highest possible speeds. A two-speed motor is fitted to give two ranges of eight speeds to the spindle. In all, there are 16 speeds ranging from 14 to 2,140 r.p.m. The spindle and driving plate are balanced to eliminate vibration. The apron, tailstock and gearbox are all of new and improved design.

A second prototype machine that will be shown is a 17 in swing sliding, surfacing and screw-cutting lathe with hydraulic gear change. The headstock has a range of 24 speeds. Speed changes are effected hydraulically. The speed change is preselected while the machine is running, and is automatically effected when the spindle is brought to rest. This machine also has an apron, tailstock and gearbox of new and improved design.

The remaining centre lathes to be exhibited are similar in character, although there are, of course, differences in capacities and in numbers of speeds and feeds. They all incorporate features that contribute to freedom from vibration and others that contribute to ease of operation. Some of these machines will have profiling attachments fitted.

The Lapointe Machine Tool Co. Ltd.

(*Stand No. 60—Grand Hall*)

One vertical and one horizontal broaching machine will be exhibited by The Lapointe Machine Tool Co. Ltd., Otterspool, Watford By-Pass, Watford, Herts., to represent the wide range of machines they manufacture. Both machines will be in operation on a varied selection of components. These machines, as indeed are all machines manufactured by the company, are hydraulically operated and electrically controlled; the main frames are of welded steel construction, adequately reinforced and stress relieved; and the hydraulic units are of the low pressure type.

The vertical exhibit will be of the pull down type. Hydraulic operation is from a pump unit working at 1,000 r.p.m. and operated by a main motor of 30 h.p.

capacity. Coolant is supplied by a separate pump unit with a ½ h.p. self-contained motor. The machine is controlled by push buttons at the front which actuate solenoid-operated valves. To facilitate setting up, there is an auxiliary control station at the side of the machine. The normal pulling capacity is 30,000 lb, and the maximum travel of the main slide is 42 in, suitable for a maximum broach length of 48 in. The cutting speeds are variable up to 21 ft per minute with a return speed of 42 ft per minute.

Automatic broach lifting mechanism is fitted to eliminate handling the broaches during the operating cycle. The platen on which the work-pieces are located reciprocates to and from the broaching position to facilitate loading and unloading. Change-over of work holders and broaches can be quickly and easily effected. All the electric and hydraulic controls are interlocked.

Lumsden Machine Tool Co. Ltd.

(Stand No. 63—Grand Hall)

A large surface grinder, specially designed for "continuous" grinding, will be exhibited by Lumsden Machine Co. Ltd., Hawks Road, Gateshead, 8, Co. Durham. This machine is primarily intended for use on parts that need to be ground on both sides. It has two spindles and two grinding wheels. Normally, the wheels are staggered so that one grinds at one level and the other at a different level. They may, however, both be used at the same level. The machine as supplied has four speeds to the table, but any reasonable speed may be obtained by changing the vee pulleys.

A portion of the table is exposed at the loading and unloading position. The work fixtures are mounted in pairs, one for grinding the first side and the second for grinding the other side of the component. Therefore, at the loading position, a completely ground component is removed, and the part-ground component is transferred to the final grinding fixture. The work can be held in fixtures that are operated by cams as the table moves round towards the grinding wheels, or in magnetic chucks, which become demagnetized at the loading position.

Each spindle has an electronic sizing device. This automatically causes the wheel to be fed down to compensate for wheel wear so that the correct size is always maintained. The device has a sensitivity of approximately 0·0005 in. The feed box gives a wide range of adjustment for the electronic control.

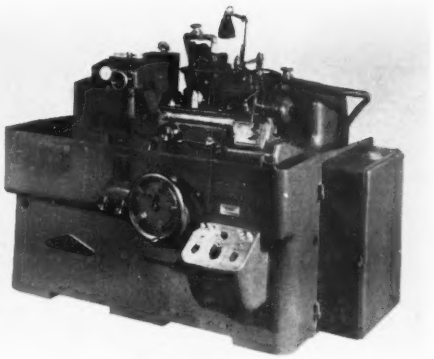
John Lund Ltd.

(Stand No. 15—National Hall)

Precision boring and facing and precision grinding are terms that engineers naturally associate with the Precimax machines manufactured by John Lund Limited, Eastburn Works, Cross Hills, near Keighley, Yorks. At the forthcoming exhibition three Precimax grinders, two Precimax fine borers and a bridge unit for a double-end fine borer will be shown.

The grinders comprise a universal grinding machine and two plain cylindrical grinding machines. A Thyratron valve control for the variable speed workhead motor is incorporated in the universal machine. One of the cylindrical grinders will have a universal workhead with live and dead centre arrangement, and will also have a "Tymcizer" built-in automatic sizing device and a hydraulic wheel truing device for a 30 in × 8 in grinding wheel. The second plain cylindrical grinder will have a "Stop-Cote" automatic sizing device.

To demonstrate the Precimax fine borers there will be a double-end machine tooled up for turning mandrel-mounted differential casings for Morris Motors. This machine has a tail-stock type of fixture that is mounted on the right-hand bridge and carries the electric push-button controls. A single-end machine, set up for boring tappet guide holes in a Jaguar cylinder head will also be shown. To complete the exhibits there will be a bridge with three fine boring heads. These heads will incorporate outfeeding angular facing slides and scissors type operating mechanism. Table and bridge cross-slides for indexing will also be fitted. This is the set-up for machining valve seats and guide bores in a Rolls-Royce cylinder head.



NL thread grinder
(Newall Group Sales Ltd.)

Gaston E. Marbaix Ltd.

(Stand No. 62—Grand Hall)

American and Swiss machine tools will predominate on the stand of Gaston E. Marbaix Ltd., Devonshire House, Vicarage Crescent, Battersea, London, S.W.11. They will include a turret lathe, a vertical boring mill, honing machines, an automatic nut tapping machine and grinding machines. There will also be a Kodak contour projector. Attention can be drawn to only a few of the exhibits.

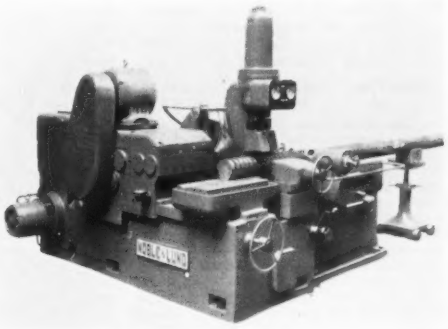
Engineers interested in turret lathe work certainly ought to examine the Gisholt Fastermatic turret lathe. This is a completely automatic chucking machine. The hydraulically-operated turret actuates the front and rear cross-slides, which are independent of each other. Therefore the cross-slides can operate together or independently with any turret station. Each Turret station has an infinitely variable feed adjustment within the range. The feed selection is automatic for each station and is obtained through standard feed cams. In addition, the spindle speed for each turret station is selected automatically by the use of standard trip posts.

There is a wide range of standard tooling for drilling, reaming, boring and turning, and in addition, the use of the turret cross facing attachment, recess boring head and internal facing tool, allows such operations as taper turning, internal recessing and back facing can be performed. Tool set-up times are comparable with those for standard turret lathes.

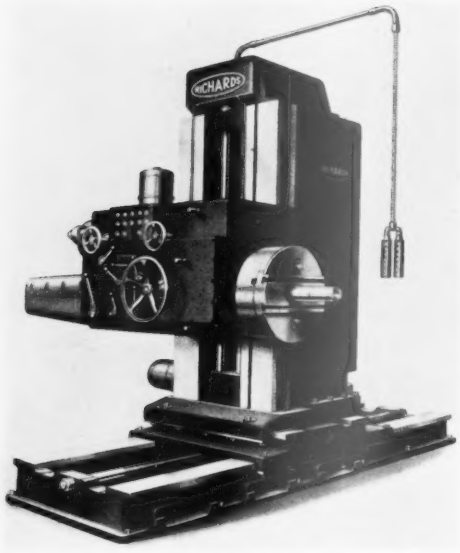
Attention may also be drawn to the Magerle surface grinders. They are designed primarily for precision production work, but they are also suitable for toolroom work. They embody an automatic down-feed to the grinding wheel spindle. This feed is infinitely variable between 0·0001 in and 0·0005 in. It may be actuated by reversal of either the longitudinal or the transverse travel of the table. Once the machine has been set, it will produce repetitions within 0·0002 in.

A Wilag "Minerva process" straight tooth flank grinding machine will also be exhibited. This machine, which employs a profiled grinding wheel, has a hydraulic drive to the table and to the dividing head. Gear tooth grinding is warranted only when the machine will produce very accurate pitch, a correct tooth profile and a very good quality of surface finish. These factors are controlled on this machine by a dividing head of great precision, a truing device that allows any desired profile to be produced on the abrasive, and the general accuracy of the machine and its freedom from vibration or chatter.

An interesting hydraulic vertical boring machine, the Barnes H-4 special Hydram, will also be shown. It is a modified version of the inverted Barnes H-4 Hydram and has a four-station rotary indexing table. The machine will be arranged for inverted drilling and boring operations, with cutting tools in the form of built-up boring bars and special "D" tool bits mounted in the indexing table for three



Automatic cold sawing machine
(Noble & Lund Ltd.)



No. 3 "Hydrabore" boring, facing, milling, drilling and tapping machine
(*George Richards & Co. Ltd.*)

distinct cutting operations at one setting.

A Delta centring machine will also be well worth inspection. It is built up simply with two Delta Milwaukee air-hydraulic drill units. Two air-operated, self-centring vices mounted on the machine bed ensure accurate presentation of the work to the tools. The jaws, which operate from an air cylinder, not only move relative to each other but also in object-and-image movement about the centre line of the machine. This is effected by a pinned link motion that maintains the centre line. One Delta unit is mounted on each end of the bed. They are controlled by solenoid-operated valves in series with air lubrication units. The maximum stroke of each unit is 4 in and the length of stroke may be adjusted to an accuracy of 0·0005 in from zero to the maximum. The fast approach to the work is controlled positively from a mechanical stop and may be set to within 0·01 in of the work. At this point the metered feed controls the quill. This feed is variable between zero and 50 in per minute. Immediately the depth control stop is reached, the air control valve is reversed and the quill is returned at the fast rate.

Morrison, Marshall & Hill Ltd.
(*Stand No. 75A—Grand Hall*)

The products of three machine tool manufacturers will be displayed by Morrison, Marshall and Hill Ltd., 44/45, Tower Hill, London, E.C.3. D. Mitchell and Co. Ltd., Parson St., Keighley, Yorks., will show lathes; Rushworth and Co., Sowerby Bridge, Yorks., will show guillotines and a press brake; and Graham and Normanton Ltd., Exmoor St., Halifax, Yorks., will show a Granor shaping machine.

Two of the machines are new. One of these is the Rushworth worm geared undercranked guillotine. This machine has been designed for high performance in conjunction with operational safety. It incorporates a special back guide to facilitate precision cutting. All the rotating parts are housed in the body of the machine and are effectively guarded. In addition, the treadle bar is located in a recess under the bed so that it cannot be operated by any falling body. This is an important safeguard during setting-up operations.

The other new machine is a 26 in shaper developed by Graham and Normanton Ltd. The machine table has tee slots in the top and both vertical faces. It can be detached from the apron, which also has tee slots, to allow large or bulky work to be bolted to the apron face. There are eight feed rates per ram stroke, horizontally from 0·010 in to 0·160 in and vertically from 0·004 in to 0·063 in. Feeds can be adjusted while the machine is in motion. The tool head is arranged to swivel through 45 deg either side of zero. It can be raised or lowered either by automatic power feed or by hand feed as required. The swivel and tilting table is arranged to swivel through 90 deg each side of the vertical and can be tilted to any angle up to 15 deg.

Newall Group Sales Ltd.
(*Stand No. 64—Grand Hall*)

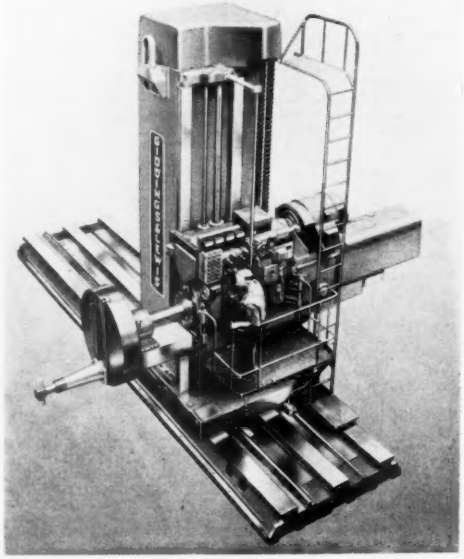
A wide range of grinding machines manufactured by the Newall Engineering Co. Limited and Keighley Grinders (Machine Tools) Ltd. will be exhibited by Newall Group Sales Ltd., Old Fletton, Peterborough, Northants. One is the 10 in × 24 in automatic "LA" cylindrical grinder, which is of new design. This is a fully automatic machine on which the operator has only to load the magazine and remove the finished components from the ejection trav. It will be shown with a 4 in wide wheel for grinding several diameters at one plunge of the wheelhead. Automatic electro-sizing is incorporated.

Another recent development that will be shown is the Newall "CL" camshaft grinding machine for automobile camshafts. This machine incorporates automatic spacing and the selection of the master cam. A Newall "NL" thread grinder will be shown for the first time in this country. It will be shown grinding taps; there will also be a selection of auxiliary equipment, including the internal and hob grinding attachment and the surface grinding attachment.

A Keighley 24 in × 96 in universal grinding machine will be exhibited. This is a truly universal machine with the wheelhead mounted on a massive turntable to ensure rigidty. The workhead is also mounted on a large diameter turntable which can be swivelled. The grinding wheel can be mounted on either end of the wheelhead spindle. Only a matter of seconds is necessary to bring the internal grinding spindle into the grinding position, and the change-over from live to dead centre for the workhead can also be effected rapidly. For ease of working, a rapid approach and run back of the wheelhead is provided.

Noble & Lund Ltd.
(*Stand No. 29—Grand Hall*)

A 22 in automatic "Fluidfeed" cold circular sawing machine and an automatic sharpening machine for circular saws will be shown by Noble and Lund Ltd., The Northern Machine Tool Works, Gateshead, 10, Co. Durham. The sawing machine has been designed specifically for automatically cutting steel bar stock into short lengths. Once the machine has been set up, the cycle is completely automatic until the whole length of bar has been cut into the requisite lengths, when the machine stops. In addition to the established "Fluidfeed" hydraulic system, this machine incorporates a number of new features. These include a spiral chip conveyor that runs while the machine is in operation and conveys the cuttings to the back of the machine where they are



Giddings & Lewis boring, drilling and milling machine
(*Rockwell Machine Tool Co. Ltd.*)

delivered into a bin. The maximum travel of the bar slide is 18 in, and there are four cutting speeds, 30, 43, 63 and 91 ft per minute. Feed rates are variable from zero to 28 in per minute.

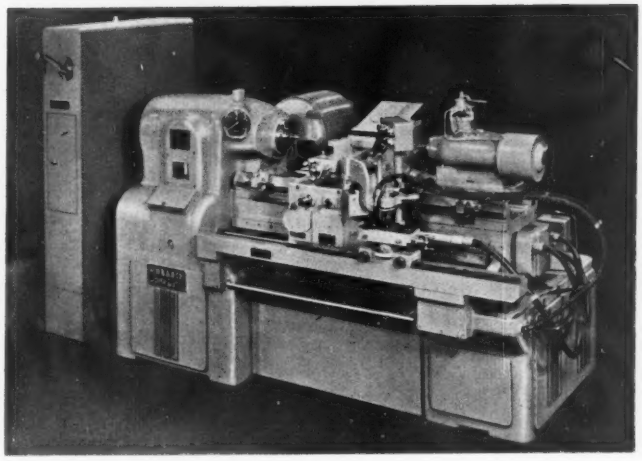
George Richards & Co., Ltd.

(Stand No. 39—Grand Hall Annexe)

Three horizontal boring, facing, milling, drilling and tapping machines, two double standard vertical boring and turning mills and a vertical slot drilling and keyway cutting machine will comprise the exhibits of George Richard and Co. Ltd., Broadheath, near Manchester. One of the horizontal boring and facing machines, the No. 3 Hydrabore, is a completely new design. It has been produced to meet the demand for a medium size travelling column machine which, whilst able to deal with large workpieces with bores at considerable distances apart, is of medium size so far as boring and facing capacity are concerned, and can therefore be run at high speeds.

Churchill patent Hydrauto type bearings carry the spindle. A motor-driven pump unit supplies the oil pressure to the spindle and a relief valve ensures that the oil pressure in the bearings is maintained constant at a predetermined value. The facing head has 12 speeds, ranging from 5 to 220 r.p.m. A totally enclosed mechanism in the head provides eight reversible feeds, from 0·005 in to 0·100 in per revolution, to the flush fitting tool slide. A total of 18 speeds is provided for the traversing spindle. They range from 5 to 500 r.p.m. The six independent speeds for the traversing spindle range from 100 to 500 r.p.m.

Brief reference may be made to the No. 5 "Electrabore" boring and facing machine, since it is a good example of the application of electric control to machine tools. The machine to be shown will be a traversing spindle type. It has a bed 10 ft wide and sufficiently long to admit 12 ft 1 in between the facing slide and the boring stay. The facing head is bolted on to the main spindle flange and has 24 speeds ranging from 1·66 to 130 r.p.m. per revolution. Totally enclosed mechanism in the head gives eight reversible feeds to the tools slide, ranging from 0·010 in to 0·125 in per revolution. These are continuous and are controlled by a single lever.



Monarch "Mono-matic" lathe
(Rockwell Machine Tool Co. Ltd.)

Rockwell Machine Tool Co. Ltd.

(Stand Nos. 49 and 50—Grand Hall)

One of the most comprehensive displays in the whole exhibition will be that arranged by Rockwell Machine Tool Co. Ltd., Welsh Harp, Edgware Road, London, N.W.2, who in addition to their two adjoining stands in the Grand Hall, will also have four stands on the first floor of the Empire Hall. In all they will exhibit some 80 high-class machine tools, most of them of American or German manufacture. These machines can be regarded as representative of the very best practice in their countries of origin. Here it is possible to mention only a few of them, and then only very briefly.

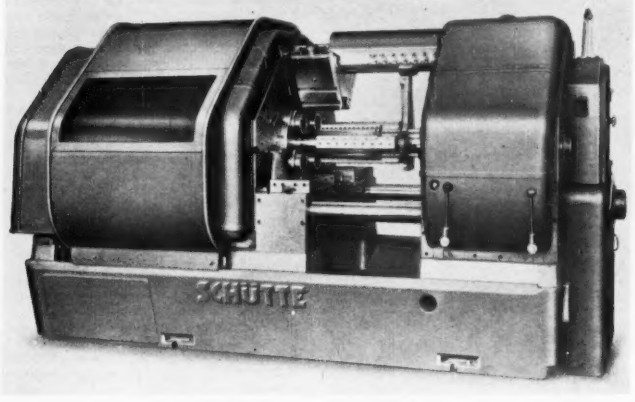
American practice for large horizontal boring, drilling and milling machines will be represented by two Giddings and Lewis products. The larger of these has a 7½ in main spindle and a 2½ in high speed spindle. It also incorporates an underarm support that allows the use of an angular milling attachment, and a shaping attachment that gives additional support for heavy milling cuts. This machine has 100 speeds and 21 feeds, and is equipped with precision scales and verniers. All functions of the machine can be controlled from either platform or from a portable control panel.

Four Monarch lathes will also exemplify American practice. One of these will be a Monarch "Monomatic" copying lathe. It is an automatic contour turning lathe that uses an air gauge tracer controlled slide for turning multiple diameters, tapers, forms and square shoulders. A power-operated, electronically-controlled rear slide is used for undercuts and rear forming operations. The machine has a dual cycle arrangement that allows roughing and finishing cuts to be carried out at one setting. Automatic pre-selected feed changes take place throughout the operation cycle.

A second Monarch machine that will be shown is the model "EE" precision lathe, which is suitable for both toolroom and production work. It has a special constant surface cutting speed headstock that automatically provides a correct speed for every operation. The actual cutting speed is shown on a surface speed-per-minute indicator and tachometer fitted to the headstock. Spindle speeds are infinitely variable up to 2,000 r.p.m. Rapid tool traverse is available in all directions, and the headstock is hydraulically clamped and power operated.

Only brief reference can be made to the other American machines. There is, for example, a Sundstrand double end milling and centring machine that performs both operations in one automatic cycle. Attention may also be drawn to the Sundstrand duplex milling machine with 11 different automatic table cycles, a 100:1 ratio feed range and an 80:1 ratio spindle head. Finally, there is the Rockford 72 in hydraulic openside shaper with a Kopykat hydraulic duplicator. The Kopykat is an accurate servo mechanism with an independent hydraulic power system. It works from a template or master, and allows both contour and full form duplicating.

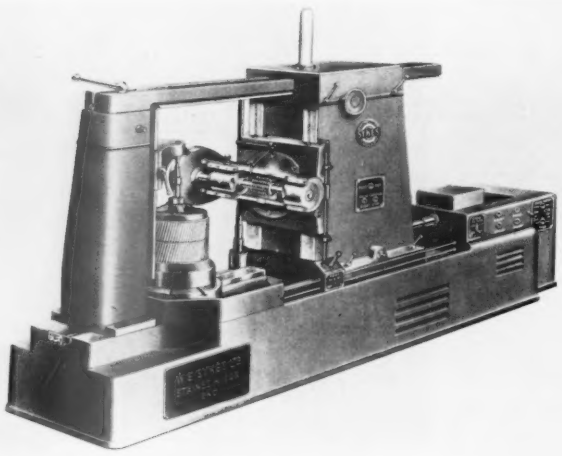
The German machines to be exhibited by Rockwell Machine Tool Co. Ltd. are so many and have such varied functions



Schütte four-spindle automatic
(Rockwell Machine Tool Co. Ltd.)

that they may almost be regarded as giving a conspectus of the German machine tool industry. Once again, it is possible to refer to only a few of the many exhibits. The new four and six-spindle Schütte automatics will certainly create much interest. They have been completely re-designed to give greatly improved accessibility. There is one longitudinal and one cross slide for each spindle, providing for many independent tool fixtures.

Current German practice in milling machine design will be exemplified by the many Werner machines that are to be exhibited. One is a duplex machine for simultaneously milling two parallel faces. Both spindle heads are axially adjustable. One head is adjustable in the direction of the table movement, and the other vertically. There are 18 spindle speeds which can be selected individually for each head. Attention may also be drawn to the Werner high power swivel head vertical milling machine. This has a 90 in × 20 in table, and a 40 h.p. main drive motor. There are 42 push-button controlled speeds in the range 16 to 1,800 r.p.m. and 50 feed rates. Speeds and feeds are shown on direct reading indicators.



HV.24 universal gear hobbing machine
(*W. E. Sykes Ltd.*)

Thomas Ryder & Son Ltd.

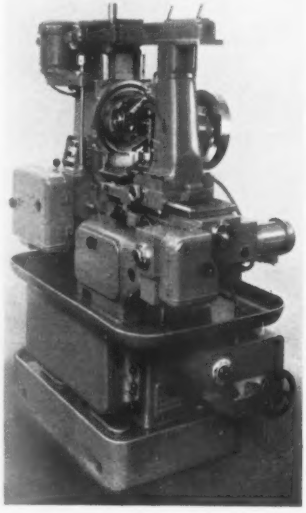
(*Stand No.* 58—*Grand Hall Annexe*)

For certain classes of work vertical lathes, either single or multi-spindle, are much more suitable than any other class of machine. To illustrate the potentialities of these machines, Thomas Ryder and Son Limited, Turner Bridge Works, Bolton, Lancs., will show a single spindle Rydermatic vertical multi-tool and chucking lathe and a six-spindle Verticalauto in operation. Although the tooling to be shown will be very interesting it is not possible to discuss it here.

The single spindle machine, a No. 18 Rydermatic, has been designed for heavy high speed metal removal with tungsten carbide tools. Normally, a 20/25 h.p. motor is used for the main drive, but motors up to 60 h.p. have been fitted to some machines. With the 20/25 h.p. motor the speed range is 54 to 540 r.p.m. Speed and feed changes are effected by means of pick-off gears. With standard cams the pick-off gears give a feed range from 24 to 400 cuts per inch. The turning and facing slides may be arranged to operate at different times in the cycle.

For work requiring multiple tools on the outside diameter, a cross-slide unit may be used. It comprises a base casting bolted on the main turning slide and carrying three cross slides. Rollers on the ends of the three slides engage cams mounted on a carrier. These cams are so shaped that the cutting tools are fed into the work and then controlled to produce the required shape. At the end of the cutting stroke, the cam carrier moves backwards and pulls the tools clear of the work. It should be emphasized that, because of the accessibility of the slides, even complex tooling arrangements can be effected quickly.

The six-spindle Verticalauto will be tooled for machining gear blanks. In this case a brief description of the tooling is perhaps the best way of illustrating the potentialities of this class of machine. Loading and unloading are carried out at the first station. At the second station, three tools on the vertical tool slide rough turn two diameters and rough bore the centre bore, while two tools on the face slide rough face a shoulder and the top face. At the third station five tools on the vertical tool slide finish turn three diameters and finish and chamfer the bore. The faces are finish machined and a groove is formed at this station by tools on the facing slide. A multi-spindle drill head is mounted on the vertical tool slide to drill four holes at the fourth station. A reamer mounted in a standard floating reamer holder on the vertical slide finish reams the bore, while a tool on the facing slide chamfers the top face at the fifth station. Finally, at the sixth station, a tangential facing tool on the facing slide turns a form on the O.D.



Pfauter R.S.000 hobbing machine
(*Vaughan Associates Ltd.*)

Arthur Scrivener Ltd.

(*Stand No.* 3—*National Hall*)

Centreless grinders, surface grinders and a profile turning lathe will be shown by Arthur Scrivener Ltd., Tyburn Road, Birmingham. In recent years this firm has developed many interesting machines that incorporate the patent Scrivener "controlled cycle." One of these machines, designed specially for automatic or semi-automatic plunge grinding of form or shouldered work will be included in the exhibits. The control wheel and work is advanced to the grinding wheel by the reciprocating movement of a hydraulically-operated cam plate of suitable contour to provide for quick approach, a predetermined rate of stock removal, a final sizing dwell, and a quick return to the open position.

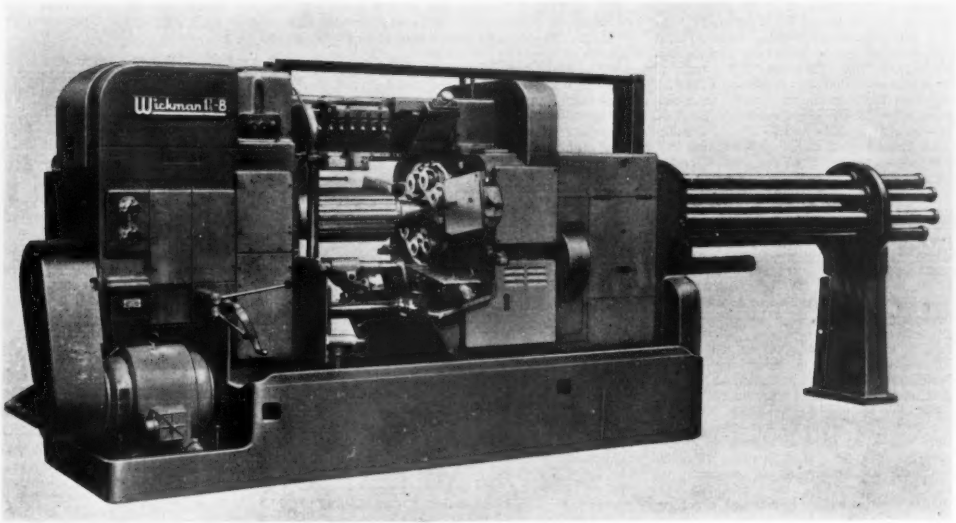
An interesting example of the firm's latest design of automatic rotary hopper will be working in conjunction with one of the other centreless grinders. It is for feeding work pieces up to about $\frac{1}{4}$ in diameter × 3 in long. In essentials the hopper consists of a flat disc rotating at high speed within a shallow casing. The components are thrown on to the rotating disc to be aligned by centrifugal force along the circular wall of the casing; they then pass tangentially through a short feed tube to the grinding throat of the machine. Production rates may exceed 30,000 pieces per hour.

The profile turning lathe will be shown tooled for machining an internal combustion engine camshaft. It is a special purpose machine on which the cam form is produced by a shaving cut instead of the more normal turning cut. Reciprocation of the tool slide is imparted by a large master cam at the rear of the machine.

W. E. Sykes Ltd.

(*Stand No.* 59—*Grand Hall*)

Accurate yet speedy production of gears is of great importance to the automobile industry. Production engineers will therefore be keenly interested in the new gear cutting machines to be shown by W. E. Sykes Ltd., Staines, Middlesex. The new V.4 vertical gear generator produces external and internal spur and helical gears up to 45 deg and 16 D.P., with a maximum of 4 in diameter and $\frac{3}{4}$ in face. If a rack cutting attachment is fitted, racks with either straight or helical teeth can



8-spindle bar automatic
(A. C. Wickman Ltd.)

be produced, as can intricate profiles. The same cutter is used for generating external gears, internal gears and racks with any number of teeth of the same pitch, pressure angle and helical angle.

Pinion type cutters are used, mounted on a vertical reciprocating spindle. Positive idler stroke cutter relief operates on the cutter head, the work remaining steady. In-feed is automatic, and simple adjustment of a shoe allows the work to be completed in one or two stages. At the end of the cycle the machine stops and the saddle retracts automatically. Large diameter micrometer drums facilitate setting. A two-speed motor and vee pulleys provide six cutting speeds.

The V.10A vertical gear generator cuts the same types of gears as the V.4, but has a capacity of 14 in diameter, 6 D.P. and 2½ in face. On this machine automatic in-feed can be set to finish the work in one, two or three stages by simple adjustment of two rollers. The machine has eight cutting speeds.

There will be two two new hobbing machines. One, the HV.24, has a capacity of 24 in diameter × 15 in face, with a maximum of 3½ D.P., and the other, the HV.40, 40 in diameter × 19 in face with a maximum of 3 D.P. Both machines are designed for the production of spur and helical gears, splines, sprockets, worms and worm wheels. The hob head is mounted on a moving column; the work table axis remains stationary. Rapid power traverse is provided for both directions of column and hob slide movement. Vernier scales are provided for accurate angular setting of the hob head, and a micrometer drum is fitted for regulating the depth of cut.

Vaughan Associates Ltd.

(Stand No. 44—Grand Hall)

Several German machines of extreme interest will be exhibited by Vaughan Associates Limited, 4, Queen Street, Curzon Street, London, W.1. They will include gear hobbers, lapping machines and a nut tapping machine. Of the gear hobbers, it is almost unnecessary to say more than that they are Pfauter machines, since the merits of these machines are so well-known and widely recognized. Even so they will create interest, since they will give many engineers their first opportunity of examining Pfauter machines of post-war design.

Two sizes of gear hobbing machines will be shown, both arranged for vertical mounting of the work. They are suitable for hobbing spur gears, helical gears, worm wheels, spline shafts and serrations. They are also suitable for climb hobbing as well as conventional hobbing. This is important, since with climb hobbing a faster cutting speed and an increased feed can be employed, with a consequent increase in the production. It also gives a better surface finish because it produces a better chip form. In addition, tool life is increased and there is less burring on the workpiece. Among the improvements incorporated we may mention a more powerful transmission to the hob spindle, an index drive with special worm gearing for adjusting backlash without altering axial distance, an overarm-type work-arbor support for mounting the workpiece rigidly to take heavy cuts, and a radial in-feed attachment with a special gear arrangement for plunge hobbing.

Three Peter Wolters lapping machines will be exhibited. One of them is an internal lapping machine that is particularly suitable for the production of components for fuel injection equipment. The lapping tool is a hardened split sleeve carried on a 'tapered floating mandrel. Workpieces are carried in a floating fixture and below the table there is an adjustable stop incorporated in the machine table. This anvil is set at such a height that the end of the lapping sleeve touches it at the bottom of the reciprocating stroke.

Fine adjustment of the lap diameter during the lapping operation is obtained by lowering by a small amount the spindle that carries the lap. This causes the split sleeve to be forced further on to the taper of the mandrel when contact is made with the stop. A graduated handwheel controls the lowering of the spindle and allows the mandrel to be expanded by known increments. Bores up to 1·97 in diameter and 3·94 in long can be lapped.

Thos. W. Ward Ltd.

(Stand No. 40—Grand Hall)

So far as the automobile industry is concerned, the main interest in the exhibits of Thos. W. Ward Limited, Albion Works, Sheffield, will be in two milling machines and a universal horizontal boring, facing, milling and drilling machine. It would appear that the "Bragonzi" universal horizontal boring and facing machine will be particularly interesting. It has a 4 in diameter spindle, which can be fed up to 30 in at one setting and 46 in at two settings. The facing head will face up to 31 in diameter. A preselector gearbox gives nine spindle speeds from 80 to 800 r.p.m. and nine facing head feeds from 6 to 60 r.p.m. Dial type feed selection gives 12 feeds from 42 to 500 mm per minute, 12 feeds from 0·05 to 0·6 mm per minute and screwcutting from 2 to 24 t.p.i. There is rapid traverse to all feeds. Vernier scales are provided for all traverses, with additional micrometer-dials for head elevation and table cross feed. The work table can be rotated through 360 deg. There is a built-in taper boring attachment.

Italian practice in milling machine design will be illustrated by two Riva machines. One is a universal machine with a table working surface of 47 in × 11 in. It has 38 in automatic longitudinal traverse, 11 in automatic cross traverse, and 18 in rise and fall of table. There are 18 reversible spindle speeds from 20 to 1,500 r.p.m. and 48 power feeds from $\frac{1}{16}$ in to 25 in per minute, with rapid power traverse in all directions. The machine is fitted with a universal dividing head and a vertical milling attachment.

Weatherley Oilgear Ltd.

(Stand No. 71—Grand Hall Annexe)

It is almost unnecessary to say that various types of hydraulically-actuated

broaching machines will be the main exhibits on the stand of Weatherley Oilgear Limited, Biggleswade, Beds. These machines are so well-known throughout the automobile industry that detailed descriptions would be pointless. There is, however, some point in briefly recapitulating some of the outstanding features of these machines, all of which are hydraulically-actuated from an Oilgear variable displacement pump with solenoid-operated pilot control.

Three of the machines to be shown are arranged for vertical broaching. One of these, the XMW "Cyclematic," passes the work over stationary tools. This eliminates the possibility of tool sag or vibration and makes possible very close tolerance broaching. The other two vertical machines are arranged for passing the broaches past the work. The only essential difference between them is that one has a single slide and the other has two slides. Automatic shuttle tables are features of these machines. In neither case can a tool slide move down until the shuttle table is hydraulically and mechanically locked in the broaching position, nor can the tool slide move up till the shuttle table has moved away to the unloading position. Not every component is suitable for vertical broaching, so one of the Weatherley Oilgear horizontal machines will also be shown.

A. C. Wickman Ltd.

(Stand Nos. 6, 7 and 8—National Hall)

One of the most comprehensive displays in the exhibition will be staged by A. C. Wickman Ltd., Coventry. One stand in the National Hall will be used solely for the company's own machines. American and Continental (except Swiss) machines will be displayed on the other two stands in the National Hall. Swiss machines will be shown on a separate stand, No. 152 in the National Hall Gallery. In addition, the company's Wimet Division will occupy a stand on the Empire Hall first floor. It will be equipped with tool and cutter grinding and lapping machines and a Wickman optical profile grinding machine.

As is only to be expected, on the stand devoted to Wickman machines pride of place will be given to their range of multi-spindle automatics. In addition to the five spindle machines on which the company built a high reputation for multi-spindle bar and chucking automatics, four and six-spindle bar automatics, which were introduced last year, and a completely new eight-spindle machine will be shown.

The eight-spindle machine is of 1¼ in capacity, but is built in the same frame size as the larger machines, and is extremely heavy and rigid. It incorporates the Wickman auto-setting mechanism, which allows alterations to feed strokes and bar feed to be effected without any cam changing. This is a feature that helps to make Wickman multi-spindle automatics economical for relatively small batch work. Many design features that have proved successful in the larger machines have been incorporated, and there are new arrangements which will extend the scope of applications for which the machine can be used.

Provision is made for bar feeding at two stations and double-indexing of the spindle drum, if required. By these means two dissimilar components can be produced simultaneously at each indexing. A range of 24 spindle speeds from 96 to 1,243 r.p.m. and 50 feeds gear combinations provide an almost infinite range of cycle times from 8 seconds to 16 minutes. The standard bar-feed length is 5 in, but this can be increased to 10 in by the use of a special bar feed. The maximum turning length is 9 in.

In all, there are 18 tooling faces; eight on the main tool block, two on independent slides at stations 5 and 6, four on cross slides and four on two double-station auxiliary cross slides. Alternative types of auxiliary cross slides can be provided for particular applications. All the cross slides are fitted with micrometer adjusting screws and master stops that engage stop screws in the spindle drum stop ring to allow small sizing errors to be cancelled out. Standard tool holders and attachments are interchangeable between machines.

All the multi-spindle automatics will be shown in operation. They will be tooled as follows:—

(1) Five-spindle bar automatic, ⅞ in capacity, producing snap-lock sockets which require side drilling and milling. Cycle time 14 seconds.

(2) Five-spindle bar automatic, 1¼ in capacity, tooled for a motor pump shaft with eccentric taper and rolled oil groove. Cycle time 40 seconds.

(3) Five-spindle chucking automatic, 6 in capacity, with automatic loading, machining a 5½ in diameter cast iron balance wheel. Cycle time 30 seconds.

(4) Six-spindle bar automatic, 2⅜ in capacity, for commutator hub and clamping ring together. Cycle time 142 seconds.

(5) Four-spindle bar automatic, 3½ in capacity, producing a taper bearing cone from tube. Cycle time 72 seconds.

(6) Eight-spindle bar automatic, 1¼ in capacity, double indexing machine, producing two components, an anchor pin and a piston, per cycle, in 35 seconds.

It is not possible to make more than passing reference to the Continental machines that will be exhibited. However, there is no doubt that an inspection of the machines to be displayed on stands 6 and 7 in the National Hall will be well worth while. These stands will be given over chiefly to German machine tools for a wide range of duties. The machines to be shown will include automatic copy millers, lathes, gear shapers and grinding machines. In fact, the range is wide enough to be representative of German machine tool practice.

Swiss machine tools have a deservedly high reputation. Some interesting examples of the latest Swiss practice will be shown on *Stand No. 152, National Hall Gallery*. Lathes, milling machines, sliding head automatics, gear hobbers and grinding machines will be included in the exhibits. Particular attention may be drawn to three Hauser jig borers and a Hauser profile projector.

NIMONIC 95

An Improved Nickel-Chromium Alloy for Gas Turbine Components

IN order to meet the demands of gas turbine designers for materials to withstand still higher temperatures and higher stresses than the alloys used in current productions, the Mond Nickel Company Limited has continued research in the field of precipitation hardening nickel-chromium alloys. The latest outcome of these investigations is the recently announced alloy Nimonic 95. The new alloy is similar to Nimonic 90 but the creep-resistance at elevated temperatures has been improved by increasing the content of the hardening elements.

All alloys having high creep-resistance at high temperatures are necessarily difficult to hot-work and one of the major problems in the development of a new alloy is to maintain forgeability to enable the material to be worked to the required form. Any increase in the maximum temperature at which an alloy is serviceable necessarily involves a reduction in the temperature interval within which hot-working must be carried out, for the increase in the amount of alloying elements does not usually produce at the same time an increase in the melting point of the alloy. By careful control of the proportions of the hardening elements and of the methods of melting and casting of ingots, however, as well as by improvements in the technique of hot-working, it has been found possible with Nimonic 95 to maintain adequate forgeability for practical purposes.

Stress to Rupture in 100 hours Ton in²	Approximate Minimum Creep Rate, 100 Hour Test Per cent hr
22	0·002–0·005
14	0·002–0·005
9	0·002–0·005
6·5	0·005–0·01
5·0	0·005–0·01

Since Nimonic 95 has been developed only within the last few months it has not yet been possible to determine its creep properties in long-time tests or over a wide range of temperatures. Its properties for relatively short periods show a considerable improvement over those for Nimonic 90 and are summarized in the accompanying table. Reading down the figures relate to temperatures of 750, 815, 870, 900 and 925 deg C.

Tests are in hand to extend the knowledge of the creep resistance of the new alloy and to determine other properties of importance to designers, but in the meantime it is being produced by Henry Wiggin & Company Ltd. and is being used in experimental quantities by engine builders. (2027)

THE R.P. LUBRICATOR

A Range of Units for Automatic Lubrication of Chassis Components

By D. A. Sams*

DURING recent years the Clayton Dewandre Company has been manufacturing various types of the R.P. automatic chassis lubricator and these have been installed in large numbers of vehicles and operated with success. To-day these units are fitted to whole fleets of vehicles and are offered by several vehicle manufacturers as standard optional equipment. It has been queried whether automatic lubrication is economically justified. Apart from the initial outlay and installation of the lubricator and pipe work, however, no further costs are involved since the lubricator is designed to last the life of the vehicle without replacements.

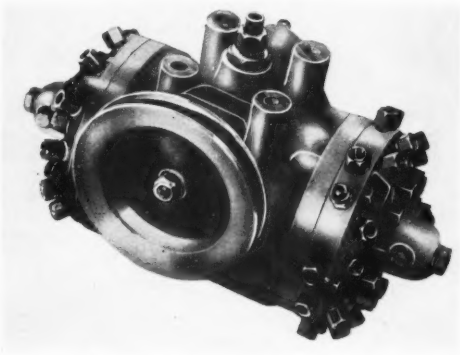


Fig. 1. A 60-point, dual-headed lubricator

As the vehicle does not have to be withdrawn from service for periodical lubrication, and the necessity for manual lubrication is largely eliminated, there is a continued saving in labour costs, combined with more effective vehicle operation. The lubricator gives a predetermined "shot" of lubricant to each point at regular intervals whenever the vehicle is in motion. The only attention required is to maintain the oil in the supply tank.

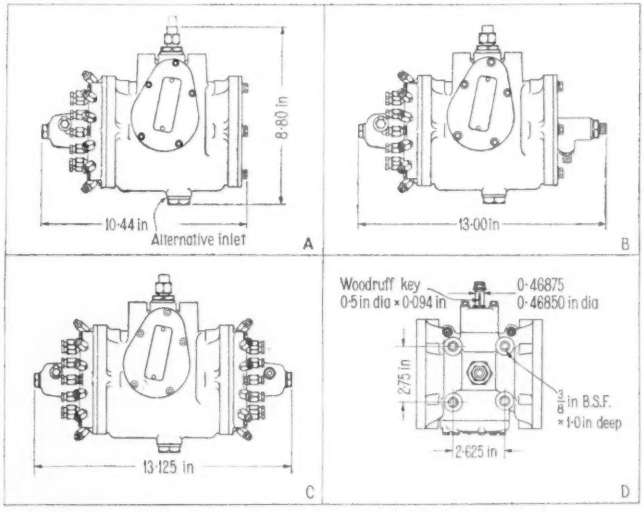
Conditions are thus created whereby wear is practically eliminated in king pins, steering swivels, shackle pins and other bearings. One company operating vehicles fitted with R.P. lubricators carried out inspection at 60,000 miles, when the results were so satisfactory that the buses were put back into service without attention until 120,000 miles were covered. At this inspection it was only found necessary to replace some spring shackle bushes.

Another large operator in Scotland, with a fleet of 40 double-decker A.E.C. vehicles, reported that these had reached between 170,000 and 200,000 miles without any shackle pins or bushes being removed. Similarly, a fleet of trolley buses operated by a Midland Municipal undertaking was examined at 100,000 miles, when wear in chassis bearings was found to be negligible.

The principle of providing a constant supply of oil is the basis of all lubrication, since where oil is being steadily forced through a bearing, dirt or water cannot enter. A feature of the modern automatic lubricating system is that there should be an independent supply to each bearing ; not more than one bearing should be fed from one supply line, so that failure or excessive wear of one bearing will not affect supply to the remainder.

With the increasing demands made on these lubricators, it became necessary to produce units capable of supplying a greater number of points, up to a maximum of 72. After considerable research and experiment, a new "Multipoint" lubricator, capable in its variations of feeding from 18 to 72 separate chassis points, has been developed and is now in production. The main advantage, from a manufacturing point of view, is that a wide range of units can be assembled from the same basic components. This permits standardization of all parts, thereby reducing production costs. Units are available with either or both of the standard 24 or 36-point delivery heads, to produce 24 or 36-point single-headed, or 48, 60 or 72-point dual-headed machines.

When the vehicle requires an



A 24 or 36-point single head
B 24 or 36-point, with AP-VAC valve
C 48, 60 or 72-point, dual head
D Drive shaft and fixing details

Fig. 2. Overall dimensions of standard units and common driving and attachment details

*Lubricator designer, Clayton Dewandre Co. Ltd.

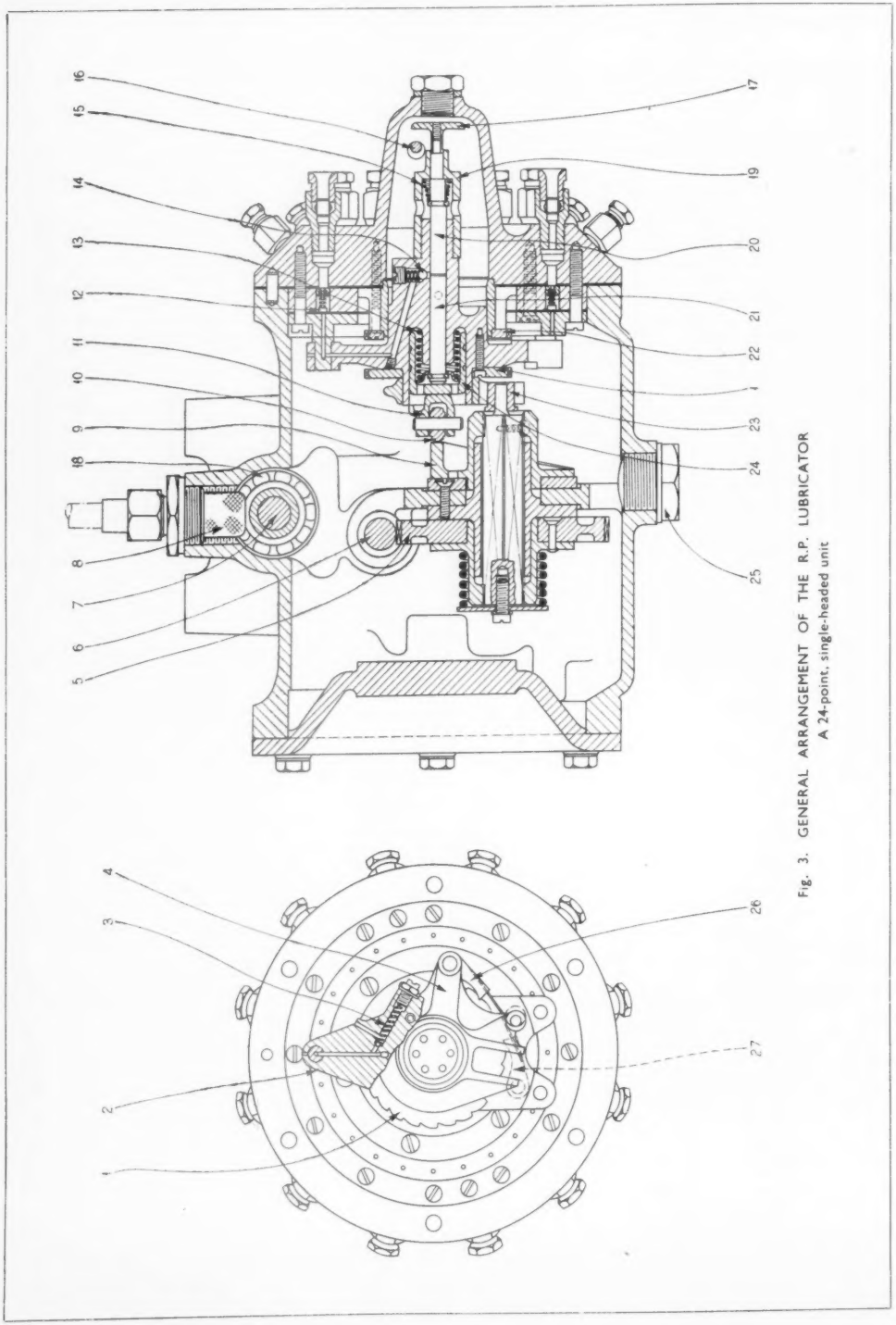


Fig. 3. GENERAL ARRANGEMENT OF THE R.P. LUBRICATOR
A 24-point, single-headed unit

intermediate number of feed points, the spare points may be used to "double up" the supply to individual bearings or by use of a special six-way return adaptor, the lubricant may be fed back to the unit.

In the case of the 24 and 36-point lubricators, one end of the unit is fitted with a blanking plate. For articulated vehicles and trailers, using vacuum or air pressure brakes, one of these units is capable of dealing with the tractor portion and, by fitting a cam-operated distributor valve in place of the blanking plate, a vacuum or air pressure-operated lubricator fitted to the trailer, may be operated simultaneously with the tractor lubricator. The distributor valve is connected to the vacuum or air pressure reservoir on the tractor and through a flexible hose and coupling to the lubricator on the trailer.

Fig. 1 shows a 60-point unit, utilizing 24 and 36-point heads. Although able to deal with a maximum of 72 chassis points, the larger machines are surprisingly compact, being approximately 6½ in wide and 13 in long. Overall dimensions are given in Fig. 2. Providing its location gives access for a direct belt drive, it can be mounted either horizontally or vertically in almost any position on the chassis. The usual method of driving is to fit a pulley on the vehicle transmission shaft coupling immediately behind the gearbox or alternatively behind the centre bearing in the case of a divided shaft. Direction of rotation is immaterial and, consequently, reversing the vehicle does not affect the operation.

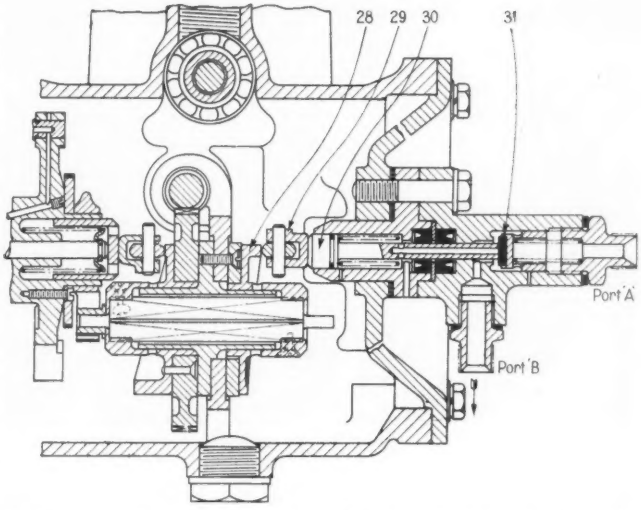


Fig. 5. Lubricator fitted with distributor value for articulated vehicles and tractor-trailer combinations

The lubricator is designed to run at 3,200 revolutions per mile; the 24 and 36-point heads lubricating each feed point every 3 and 4½ miles respectively. It delivers to each point a maximum shot of 0·10 cm³ of oil. Although it is usual to set the machine to this maximum delivery during the vehicle running-in period, it may be reduced for later service. Adjustment is possible to give a minimum of 0·05 cm³ per shot.

To illustrate the economy of the "Multipoint" lubricator, a 72-point unit delivering an average of 0·075 cm³ per shot uses only a gallon of oil in approximately 4,000 miles, during which each point would receive its quota every 4½ miles. This provides far more efficient lubrication than periodical application every 500 miles and in many cases vehicles on long runs do not get even this service. The waste of oil or grease commonly associated with manual lubrication is, of course, almost completely eliminated.

Clean oil is pressure-fed to each bearing at regular intervals, proportional to the mileage covered. Before leaving the works each lubricator is carefully run in, tested, and the relief valve set to operate at 2,000 lb in². So for an extremely tight bearing the pressure would build up in that particular line before releasing back to the machine, although this is seldom required in practice. In the event of a broken line or loose connecting union, only the point to which the line is connected suffers a shortage, the other chassis points being unaffected. Since the internal mechanism of the lubricator is completely immersed in oil, the unit invariably outlasts the life of the vehicle to which it is fitted.

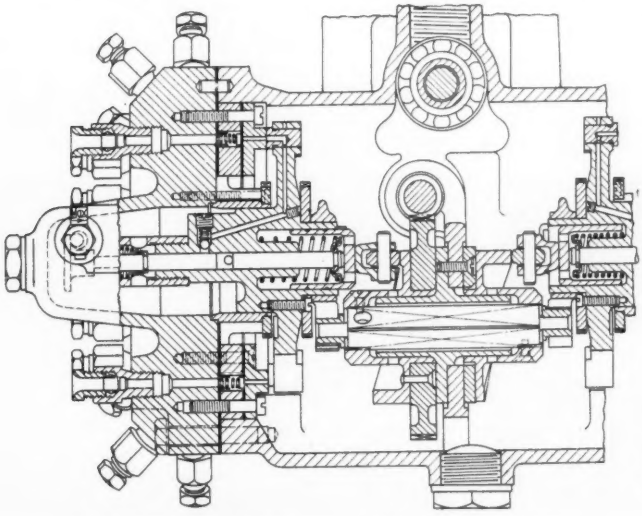


Fig. 4. Arrangement of driving mechanism for dual-headed lubricators

Construction and operation

A wide range of oils may be used in these lubricators. Best results are, however, obtained by using a fairly heavy lubricant, the limitation being that it must flow sufficiently well in cold weather to keep the lubricator fed by gravity.

Earlier type mechanical lubricators were driven by a flexible cable. The

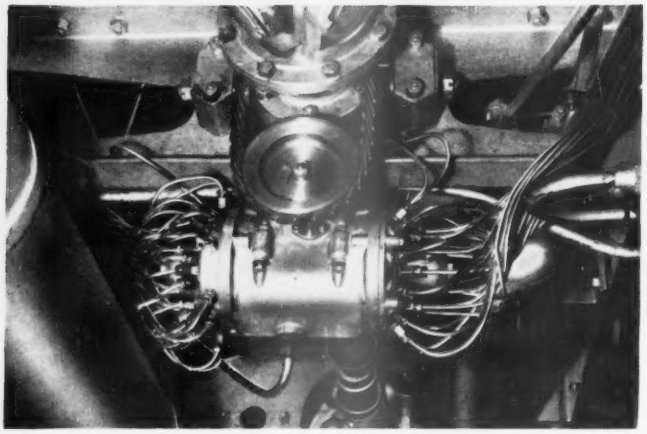


Fig. 6. A 60-point unit installed on a Thornycroft eight-wheeler

new machine is of similar design, embodying the same type of 24 or 36-point distributor heads, but includes an additional reduction gear within the housing. Fig. 3 shows sections of a 24-point, single-headed unit.

The pulley drive shaft 7 runs in ball bearings and is geared to the worm shaft 6 which in turn drives a worm wheel 5, the ratios being 4 : 1 and 100 : 1 respectively. Thus for every 400 revolutions of the pulley, the worm wheel makes one complete revolution to produce a shot of lubricant to one of the feed points. Each head, whether 24 or 36-point, gives eight shots per mile at the pulley speed of 3,200 revolutions per mile.

Secured to the worm wheel is a face cam 9 and bearing against this cam is a roller 10, carried in a vertically pivoted lever 11, the free end of which abuts against the guide cap 24 and main plunger 21. The rotation of cam 9 for the first half of its revolution causes the plunger to move to the right. Oil which has already entered the plunger bore through a hole in the rotor body, is trapped between the main plunger 21 and the delivery plunger 20, and is moved along the bore. When the plunger 20 comes to rest against its stop 19, further movement of the main plunger forces the oil past the ball non-return valve 14 through passages drilled in the rotor feed arm 2 into the appropriate orifice in line with one of the delivery pipes. Further rubber non-return valves 12 are fitted to the distributor head to hold any pressure built in the pipe line whilst the feed arm 2 is moving to the next orifice. During the second half of the revolution of the face cam, the plungers are returned to their original positions by the springs 13 and 15.

Indexing the feed arm

During the cam rotation, a square die block 23 pivoted eccentrically on an extension of the cam drive shaft and fitting in a slot in the indexing pawl carrier 4, moves this pawl carrier through an angular rocking motion.

On the forward movement an indexing pawl 26, fitted on the carrier 4 and engaging with the teeth of rotor ratchet 1, turns the feed arm 2 to the orifice in line with the next delivery pipe. The backward movement allows the pawl 26 to retract over the ratchet wheel teeth to prepare for the next movement of the feed arm. To prevent the feed arm 2 from slipping back during this movement of the indexing pawl 26, a second pawl 27 is fitted to the feed arm and engages the teeth of a fixed ratchet wheel 22 secured to the lubricator body.

Adjustment of oil feed

The indexing ensures that every lubricating point will receive its quota of oil in rotation and no matter in which direction the drive shaft 7 is rotated the feed arm 2 always travels in the same, clockwise, direction. An oil relief valve 3 is incorporated in the rotor feed arm, and set to release if a pressure of 2,000 lb in^2 is built up in any of the feed pipes.

The oil feed can be adjusted by increasing or decreasing the volume between the two plungers, 21 and 20. This is effected by limiting the travel of the delivery plunger 20. A circular stop 17 fitted to plunger 20 abuts against the eccentric adjuster pin 16, a turn of which through 180 deg will give a maximum adjustment.

Dual headed machines

Fig. 4 shows a section of the driving mechanism of a dual-headed machine. This operates as previously described, the worm wheel driving two face cams and having a die block at each end of the cam shaft. The face cams are arranged so that each distributor head is operated alternately.

When the lubricator is used on articulated vehicles or for tractor-trailer combinations, a distributor valve is fitted to one end of the unit,

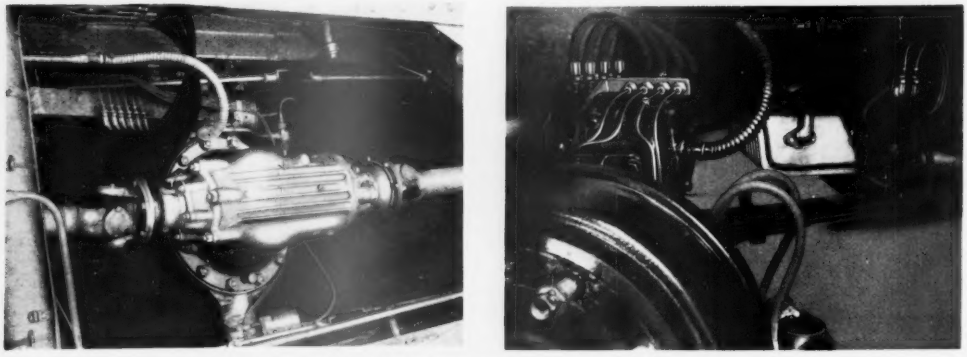


Fig. 7. Flexible rubber tubing is used for undercarriage connections

as shown in part section, Fig. 5.

Vacuum or air pressure from the tractor brake reservoir is connected to Port "A" of the distributor valve. A second face cam 28 driven by the worm wheel 5 operates, through the vertically pivoted roller 29, a spring-loaded valve stem 30. Rotation of the worm wheel causes the valve stem to be depressed against a rubber-faced valve 31, first sealing off the atmospheric connection and then permitting vacuum, or air pressure, to be communicated by way of Port "B" and the connecting pipe line to the lubricator fitted on the trailer. During the second half of the rotation of the face cam, the valve stem 30 returns, sealing off the vacuum, or air pressure, and permitting atmosphere to enter the trailer pipe line. This action produces impulses, which operate the trailer lubricator at a feed rate of eight points per mile.

A number of prototype installations have been made in the Clayton Dewandre experimental department, and the equipment as fitted to a Thornycroft "Trusty" eight-wheeled, rigid goods vehicle is here described.

Typical chassis installation

The lubricator is mounted horizontally on a bracket beneath the centre frame cross member and is belt-driven from the transmission, as shown in Fig. 6. Oil is supplied from a one-gallon reservoir mounted above the lubricator on the chassis side frame.

A total of 59 points on the chassis are lubricated, the transmission shaft intermediate bearing, adjacent to the lubricator, receiving a double quantity of lubricant. All possible points on the chassis are lubricated as listed below :—

Propeller shaft intermediate bearing 1 ; Front springs, pins and shackles 12 ; Rear springs, pins and trunnions 8 ; Rear springs, centre bearing 4 ; Front axle, swivel pins 8 ; Steering track rods 4 ; Steering drag links 6 ; Steering relay bracket 1 ; Clutch relay 1 ; Clutch operating shaft 2 ; Hand brake relay bracket 1 ; Hand brake gear bracket 1 ; Hand brake bellcrank levers 2 ; Brake camshaft bearing (outer) 4 ; Brake linkage, 4.

Even on such a large vehicle, with the dispersed locations of the points to be lubricated, the installation proved to be simple and straightforward, forming a neat installation. Approximately 950 ft of piping was used, undercarriage connections being made with flexible rubber tubes, see Fig. 7.

RECENT PUBLICATIONS

Brief Reviews of Current Technical Books

The Story of the S.M.M.T. 1902-1952

By St. John C. Nixon.

London: SOCIETY OF MOTOR MANUFACTURERS AND TRADERS LTD., 148, Piccadilly, W.1. 1952. 5½ × 8½. 130 pp. (A limited number of copies are available from the Press Office of the S.M.M.T. against a remittance of 10s.)

Any story about a particular aspect of the motor industry is full of interest for those engaged in this business and who like to be reminded of its many ups and downs in the past fifty years. The S.M.M.T., founded fifty years ago, has a history which, if told in detail, would occupy several volumes. Therefore, the reader of this book must bear in mind the words of the present President, G. E. Beharrell, in his preface, " Not a complete history, not a detailed account of all its activities . . . but for those who played their parts in the earlier years it is an outline which they will be able to colour with the brush of remembrance . . . it is a record condensed and distilled of the part the Society has played in the growth of the British motor industry from the first efforts of the internal combustion engine."

A book of this type necessarily includes a deal of facts and figures which must seem uninteresting to those who were not connected with the industry in its early days. This is probably the most reliable condensed version that could be written in so little space. It is thought, however, that the history of the S.M.M.T. could contain more romance than Mr. Nixon includes, more personal notes, more details of struggles and achievements. True, the author does not paint a picture of easy and unhindered development, but some of the descriptions of events might have been coloured by incidents which, although not essential, would make the book more easily readable. As a historical work, it gives the facts of the growth of the S.M.M.T. with the automobile industry faultlessly, but the achievements of the industry and the Society, and the struggles to secure them, must include unwritten detail that might have been stated here for permanent record.

Nevertheless, the book is most certainly an important contribution to automobile history. It covers each decade of the Society separately, portrays all the Presidents, lists the honorary officers from 1902 to 1952, draws attention to the Society's interest in and representation on various scientific bodies, includes descriptions of the first and subsequent motor shows for which the Society has been responsible. It is a dignified description of a great Society which has done much to ensure the smooth running of the vast automobile industry it represents nationally and also in the international sphere.

Automobile Chassis Design

By R. Dean-Averns.

London: Published for *Automobile Engineer* by ILIFFE & SONS LTD., Dorset House, Stamford Street, S.E.1. 1952. 5½ × 8½. 363 pp. Price 30s.

The first edition of this book appeared in 1948. In his preface the author states that formerly it was customary to consider a motor vehicle as a prime mover coupled to a mechanical transmission and to mount these units as assemblies in a frame to form a chassis. To-day, the vehicle must be considered as a whole, the means of propulsion being provided in positions which are subordinate to this main duty. Hence this second edition has been revised and enlarged, and whilst addressed particularly to designers and draughtmen, should also prove of interest to others engaged in the automobile engineering industry.

Commencing with vehicle performance, the author covers gradient resistance, tractive effort and resistance, stability, effect of tyres on chassis vibrations, rolling resistance and effect of centre of gravity. He then deals with vehicle suspension (although another chapter is included later in the book on road springs). This chapter includes only basic theory, and goes into details concerning sprung and unsprung weight, brake assemblies, shackle positions, obtaining oscillation frequencies, stiffness and rolling couples. The reader is then prepared for the next chapter on independent suspensions and the following one on front axles, since much of the basic theory is needed for all these subjects.

Under steering will be found considerable information on wheel balance and power steering. All aspects of steering are discussed in a logical and easy-to-read manner, and under power steering the Ross-Bendix integral hydraulic gear, the Bendix-Westinghouse mechanism, and the Vickers hydraulic booster are all described. Vehicle braking covers the mathematics of simple two-shoe brakes, self-energized two-shoe brakes, brake lining pressure, lining disposition, brake efficiency and a few notes on brake squeal.

Chapters are devoted respectively to the frame and to chassisless construction and these are followed by measurement of stress, which perhaps should come first.

The rest of the book is devoted to chassis parts in turn, covering road springs, transmission, gearbox, rear axles and differential. The section on rear axles includes considerable information on hypoid gears and their mounting.

The final chapter is concerned with chassis layout. The author assumes that the design of the main units has been settled, and proceeds to detail how they can be installed in the chassis with as few parts as necessary, providing complete accessibility, without subjecting any part to excessive stresses even when under severe operating conditions, without incurring heavy costs, and in accordance with the law appertaining to this work. He includes stability of public service vehicles with the various statutory rules and orders, positions of radiator, pedals, driving position, brakes, steering, gear change, fuel layout and electrical system.

The information given is applicable to both petrol- and diesel-engined vehicles and although the references and illustrations are mainly of heavier vehicles, the facts given apply equally well to light vehicles. Intentionally the book does not deal with the prime mover.

Those who possess the first edition might care to know that the second edition contains chapters on the technique of independent suspension and chassisless construction, new information concerning stress measurement, a few pages on anti-corrosion treatment of metals, some additional notes on spring design and on streamlining. The book includes 250 illustrations and is a most valuable addition to any library on automobile engineering.

The U.S. Market. Principal Features and Basic Statistics

London: O. W. ROSKILL & Co. (REPORTS) LTD., 14, Great College Street, S.W.1. 1952. 7½ × 13. 232 pp. (mimeographed). Price 42s.

Any firm contemplating marketing goods in the U.S.A. should buy this work and carefully read all relevant sections. Those already marketing goods in the States but wishing to increase their sales or to introduce certain lines in particular areas should also secure this book. Similarly, those who seek to ascertain why certain areas in the States bring better sales than others will be likely to find the solutions here. In short, we doubt if any company trading with the United States should be without these facts and figures and we know of no other source where they can be referred to so easily and so quickly as in this collation of a vast wealth of information about that country.

Commencing with general characteristics such as climate, population distribution, income groups, wholesale sales and retail sales, each of these sections provides innumerable facts and figures. We are then given detailed information on regional markets. For example, the States of Arizona and California increased their population by over 50 per cent between 1940 and 1950. We are given the number of plants, and also the number of employees engaged in a wide variety of manufacturing plants, State by State. Similarly, the number, acreage and value of farms is listed. We are given highest and lowest temperatures recorded in winter and summer in various districts. It is impossible to enumerate adequately the wide variety of Tables, charts and descriptive matter outlined in these pages, but it can be stated that nearly all—if not all—available statistics of use to intending traders have been collected.

Most of the book is devoted to Selling to the United States and a Review of the Market for Some Selected Commodities. These commodities include woollen textiles and clothing; cotton manufactures; motor vehicles; cycle and motor cycles; textile machinery; machine tools. In most cases the sub-headings in each section are statistics of sales, sources of supply, channels of distribution, tariffs, types of U.K. goods likely to sell in the U.S.A., and a bibliography of literature for further reference.

The motor industry will find much of interest in the section on motor vehicles. For instance the number of vehicles licensed by the State, by age groups, by income groups, and by various other groups, are interesting to compare with figures in this country. Between 1949 and 1950 the number of householders in the States rose by 1½ million but the number of cars increased by 4 million. The average age at which cars are scrapped has risen from 10 years before the war to 13 years now. Only 180,000 of the 6·67 million cars made in the United States in 1950 were exported and only 150,000 of the 1·33 million trucks. These extracts have been taken at random from the section on motor vehicles, and all sections contain similar material in profusion. The book is certainly a material aid to our drive for exports to the United States.

Mechanics of Vibration

By H. M. Hansen and Paul F. Chenea. New York: JOHN WILEY & SONS INC. Available from Chapman & Hall Ltd., 37, Essex Street, London, W.C.2. 1952. 5½ × 9. 417 pp. Price 64s.

The frontispiece to this volume depicts a typical fatigue failure due to vibration. It shows a broken spring, presumably a valve spring and the type of fracture is that commonly associated with fatigue. Breakages by fatigue are usual in all parts subjected to a considerable length of arduous life, but life is rapidly shortened when subjected to vibration. It is because breakages due to vibrational fatigue can have such far-reaching effects that this work assumes great importance to all designers and students of engineering. The practising engineer to-day needs training in the technique of vibration analysis and this book covers the subject sufficiently thoroughly to enable him to apply the knowledge to many diverse vibrational problems in his own specific sphere of industry.

This is primarily a textbook for the undergraduate engineering student and is certainly an important contribution to any list of recommended books that he will need. Designers will find much that will interest them and a great deal more that they should assimilate if their work includes the design of any parts subjected to severe vibration.

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The book is divided into three parts. Part One deals with systems of one degree of freedom and is subdivided into sections dealing with free and forced vibrations without damping, and forced vibrations with damping, respectively. Part Two covers systems of several degrees of freedom and derives and solves equations by the classical method, the mobility method, and with the use of the complex variable. Holzer's and Graeffe's methods for solution of the general frequency equation are given. Part Three deals with systems with distributed physical constants (including longitudinal, torsional, and lateral vibrations in elastic bars and shafts), vibrations of transient character, and vibrations of non-linear character (including motion of a pendulum for large amplitudes and systems with the restoring force linear in segments).

Energy methods are employed generally, and Rayleigh's method for the determination of natural frequencies is used for continuous systems. The concept of relaxation frequency and its physical meaning is introduced and used.

Of value to the student are the number of problems appended to each chapter with their answers at the end of the book. Both authors are Professors of Engineering Mechanics at Michigan University and have certainly made an intensive study of this important subject. Mr. Hansen has, in fact, acted as consultant on many industrial vibration problems.

The Gas Welding of Aluminium

London: THE ALUMINIUM DEVELOPMENT ASSOCIATION, 33, Grosvenor Street, W.1. 1952. 5½ × 8½. 68 pp. Price 2s.

Information Bulletin No. 5 was first published in 1943, and now appears in revised form in view of the developments that have occurred both in materials and in the technique of welding aluminium. The use of aluminium and its alloys in industry generally, and certainly in the automobile and its branch industries, has increased during these last ten years. These alloys have enabled designers to provide improved power-to-weight ratios in both engines and complete machines, all without loss of an adequate factor of safety. The welding of these materials, therefore, grows in importance but the correct technique, which is not difficult, must be acquired. The Aluminium Development Association does good work in furthering the use of aluminium and one way in which it achieves its aim is by publication of these bulletins.

The object of this booklet is to present, in simple language, the details entailed in gaining the requisite experience with gas welding of aluminium so that the operator will have confidence in his work and will know that he is carrying out his job efficiently. Metallurgical and other factors of welding are not included in this very practical bulletin. Principal chapters comprise Gas welding process, Preparation of parent metal, Welding technique, Treatment after welding, Atomic hydrogen welding, Inspection of welds (visual, radiographic, and pressure), Properties of gas welds, Precautions to reduce distortions and Estimating welding costs. The appendices cover the specified composition of aluminium welding wire and aircraft specification numbers related to B.S. 1470-77 and 1490. A short but useful bibliography is included. The book will prove of great assistance to all who weld, or who may have to weld, aluminium and its alloys, and they should not be without it.

ETHYLENE GLYCOL

Its Use as an Engine Coolant in Cold Temperatures

By J. L. Koffman, Dipl. Ing., A.M.I.Loco.E.

TO prevent freezing of the coolant for engines in vehicles operating in cold weather conditions, use is often made of ethylene glycol as a freezing point depressant.

Because of the relatively large system capacity, the use of glycol is generally less attractive with heavy vehicles on account of the cost involved. Here the cooling system is either drained to prevent freezing in the case of vehicles laid up for some time, or the coolant is maintained at suitable temperatures with the help of heaters. However, with a wider use of pressurized cooling systems and the resulting smaller system capacity, together with very much reduced losses, the use of glycol may well become more attractive.

Physical properties

Ethylene glycol ($C_2H_4(OH)_2$) is a free-flowing, viscous liquid of a very low volatility and is not readily lost by evaporation. Consequently, any loss due to evaporation can be compensated by adding water only without adversely affecting the anti-freeze property of the solution. The dependence of freezing temperature upon the solution density is shown in Fig. 1. This is the equilibrium or phase diagram of the solution, very similar to that of phase diagrams of binary alloys. Similar to these, the intersection of the descending liquidus lines describe a mixture of the lowest freezing point of the system which may be called an eutectic mixture or composition. The chain-dotted line in Fig. 1, which is of recent origin (1), does not confirm the two eutectic points suggested by earlier investigators (2), the two lines intersecting at a single eutectic point at 62 deg C, corresponding to about 67 per cent by weight of glycol (3).

When aqueous glycol is progressively cooled, it does not suddenly freeze to a solid mass in the manner water does when similarly treated. At the freezing point of the solution, small crystals separate until there is a mass of soft crystals. The last stage, which results when a still lower temperature is reached, is the formation of a solid block, and this last stage is dangerous to the cooling system. The formation of crystals calls for a margin in the determination of glycol concentration, whilst cocks of adequate size should be provided to facilitate draining of the system. The presence of glycol also raises the boiling point of water, Fig. 2, (4), but this advantage is reduced by other features of the fluid such as increased viscosity and reduced specific heat, Figs. 3 and 4, which reduce the heat absorbing and dissipating properties of the cooling circuit.

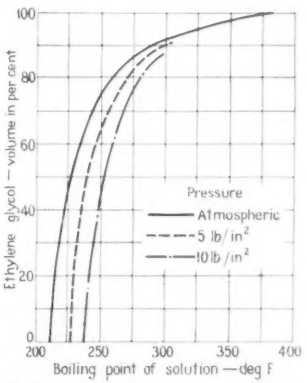


Fig. 2. Boiling temperatures of ethylene glycol

To facilitate mixing, simple rules should be adhered to. For example, a solution made up of one-third glycol and two-thirds water should be sufficient to ensure safe operation down to —4 deg F.

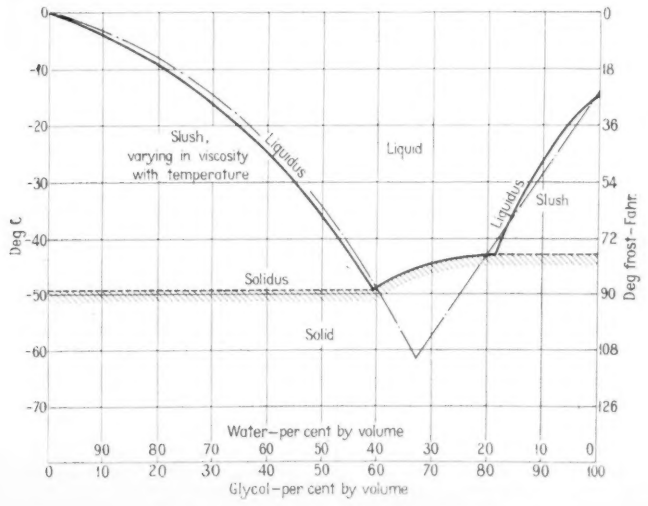


Fig. 1. Anti-freeze properties of ethylene glycol

Effect on radiator performance

To ascertain the effect of glycol upon the performance of radiators, extensive laboratory tests were carried out with matrices of a type widely used on road vehicles. The blocks incorporated either five or ten tube rows, the block depth being $3\frac{1}{8}$ in and 5 in respectively. The locked seam tubes are 0·525 in long, 0·10 in wide and are made from 0·008 in brass strips, while the gills are made from 0·004 in copper strips incorporating small ridges or indentations to create additional turbulence. At the front, the edges of the gills are turned over to stiffen them and to present a finished appearance. The block is solder dipped. In the case of the tests dealt with, the matrices had eight gills per inch. When filled with water, the weight of the matrices was 12·6 and 22·3 lb/ft² respectively.

The results of typical tests are given in Fig. 5, showing the influence of glycol concentration on heat dissipation and pressure losses. Throughout the tests carried out to determine

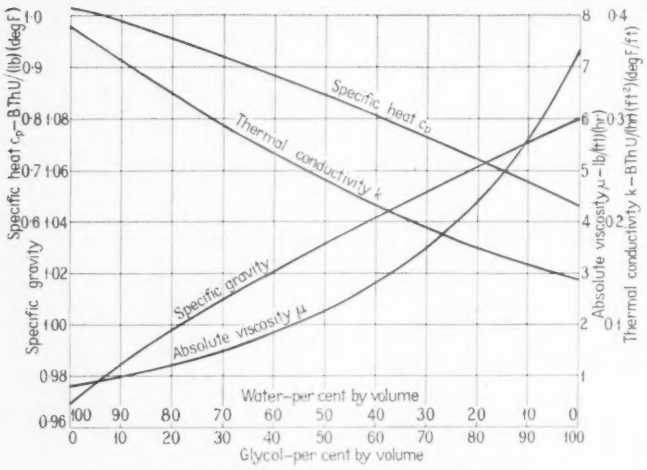


Fig. 3. Physical properties of glycol solutions at 180 deg F

the effect of air velocity on heat dissipation, the coolant flow through the tubes was kept constant at 20 gal (min)(ft width), the resultant velocity through the tubes being about 1 ft sec and 2 ft sec for the ten-row and five-row matrix respectively. In the case of varying coolant flow, the air velocity was kept constant at 20 ft sec.

It may be recalled that heat dissipation due to forced convection is given by Nusselt's fundamental expression :—

$$Nu = Re^a \times Pr^b \times C$$

where:

- Nu = hD k = Nusselt Number
- Re = DV ρ μ = Reynolds Number
- Pr = c_p μ k = Prandtl Number
- h = surface coefficient of convection, B.Th.U (hr) (ft²) (deg F)
- D = dia. of fluid stream, ft. For non-circular sections, D = $4r_h$ where r_h = hydraulic radius = cross section wetted perimeter
- k = thermal conductivity, B.Th.U (hr) (ft²) (deg F ft)
- V = Velocity ft hr.
- ρ = density, lb ft³
- μ = absolute viscosity, lb (ft) (hr)
- c_p = specific heat at constant pressure, B.ThU. (lb) (deg F)
- C = a constant

In the case of turbulent flow, for the matrix concerned a = 0·7 and b = 0·33, whilst for laminar flow, both a and b = 0·33, neglecting the factor embracing the effect of difference of viscosity at average fluid bulk temperature and viscosity at the average temperature of the inside surface of the tube. The critical value of Re above which the flow changes from laminar to turbulent is about 2,350 (the actual range is between 2,000 and 4,000). To facilitate the appreciation of the influence of the various values upon h (which can be determined from the above equation for the Nusselt No.), the values of h, k, ρ, μ and c_p are given in the table, together with the values of Re and Pr, for V = 3,600 ft hr and the glycol concentration maintained for the tests. The value of D was 4 × 0·048 1·14 = 0·1685 in = 0·014 ft.

It will be noted that the increased value of μ appreciably reduces the value of Re and this in turn results in transferring the flow from turbulent to laminar with a resultant reduction of a from 0·7 to 0·33. In the case of the 32 per cent aqueous glycol solution the theoretical value of Re indicates laminar flow for the ten-row matrix and this is confirmed by the tests, whilst in the case of the five-row unit, the high value of Reynolds number results in turbulent flow and more effective heat transfer. The test results do not confirm the large difference of the h-values for the matrix concerned. The influence of laminar flow conditions is, however, apparent in the deviation of the heat dissipation versus air velocity curves for 62 per cent and 85 per cent glycol from a = 0·7 to a = 0·33 at higher air velocity. Another reason for the heat dissipation being better than indicated by considering h only is due to the reduction of mass flow of air through the matrix.

Tests carried out with a single-tube heat exchanger at Re = 14,500 to 112,500 indicate that the ratio of h-values obtained by using water, 30 per cent, and 70 per cent glycol, all at 200 deg F. was 1:0·7:0·37. As long as glycol is added to the water during cold weather only this matters little. The reduction of heat dissipation resulting from change in Re values will, in fact, help to keep the circuit warm, but due consideration should be given to this aspect of performance if it is intended to keep glycol in the system all year round. Here, again, the effects might not be very adverse with non-pressurized systems because of the higher boiling temperature and the consequent effect on the cavitation proximity of the coolant pump (5). Reference to Fig. 2 might alleviate doubts so far as boiling is concerned, although at low glycol concentrations the increase of t_{max} might not offset the reduction in Q

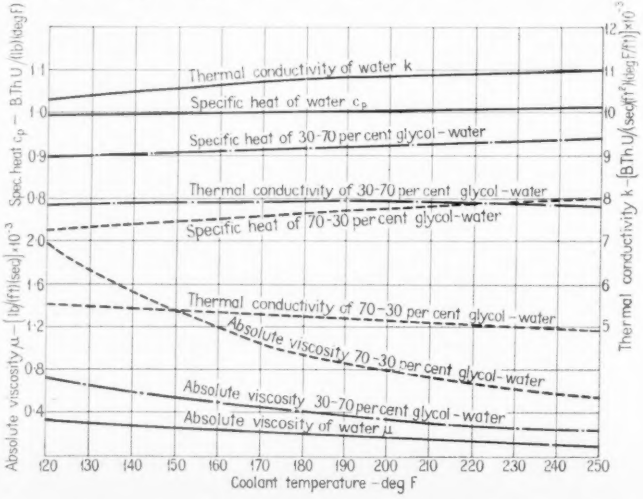

Spec. heat c_p – B.Th.U/(lb)(deg F)
Absolute viscosity μ – [lb/(ft)(sec)]·10⁻³
Thermal conductivity k – [B.Th.U/(sec)(ft²)(deg F/ft)]·10⁻³
Thermal conductivity of water k
Specific heat of water c_p
Specific heat of 30-70 per cent glycol – water
Thermal conductivity of 30-70 per cent glycol – water
Specific heat of 70-30 per cent glycol-water
Thermal conductivity of 70–30 per cent glycol – water
Absolute viscosity 70-30 per cent glycol-water
Absolute viscosity 30-70 per cent glycol-water
Absolute viscosity of water μ
Coolant temperature – deg F

Fig. 4. Physical properties of glycol solutions at various temperatures

due to reduced value of h. On the other hand, limits will be set to t_{max} by considerations of piston ring sticking, possibly consequent upon high coolant temperatures.

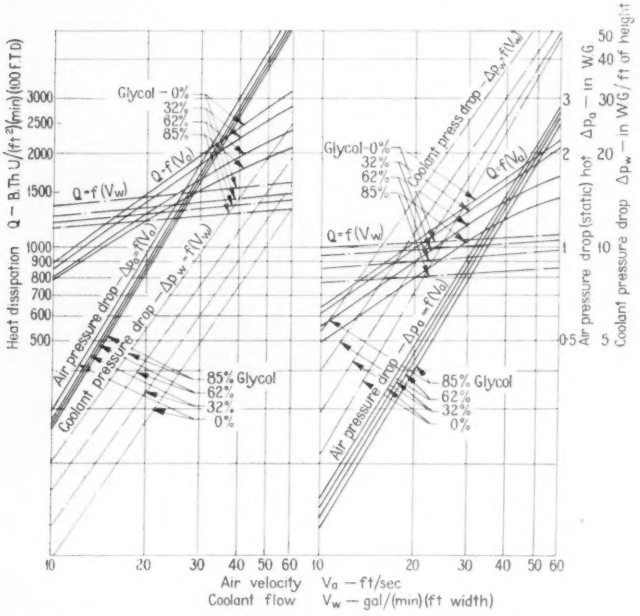
Theoretically the use of glycol will result in a rise of temperature of the coolant passing through the engine in proportion to the specific gravities, the specific heats and the rates of delivery of the liquids. Assuming the same rate of delivery the increase of temperature rise of the 32 per cent solution at 180 deg F. will be :—
(1·002 0·915) (0·97/1·012)—1 × 100 = 10·6 per cent.

Engine rig tests have shown that the amount of heat rejected to coolant is reduced as the volume of glycol in the solution increases. For example, the heat rejection was reduced from 100 per cent for water to 97 per cent for a 30-70 per cent glycol-water solution and to 93 per cent for a 70-30 per cent solution (6).

Actual vehicle tests have shown that the use of a 33 per cent glycol-water coolant will increase the cooling system temperature by about 5 deg F. but this increase is compensated by the higher boiling temperature of the solution.

COOLANT AND HEAT TRANSFER DATA AT 180 deg F

	Percentage of Glycol			
	0	32	62	85
k	0·398	0·287	0·212	0·164
μ	0·802	1·55	2·95	4·95
c_p	1·002	0·915	0·8	0·7
ρ	60	62·5	64·5	66
Re	3,780	2,035	1,100	672
Pr	2·03	4·93	11·15	21·1
h	12,230	432 7,650	330	280



Left: ten-row tube matrix; right: five-row tube matrix. F.T.D. = temperature difference in Fahrenheit degrees

Fig. 5. The effect of glycol on performance

Actual vehicle tests have shown that the use of a 33 per cent glycol-water coolant will increase the cooling system temperature by about 5 deg F. but this increase is compensated by the higher boiling temperature of the solution.

Acknowledgment is made to the Chief Scientist, Ministry of Supply, for permission to publish this article.

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IMPREGNATING POROUS CASTINGS

A PROCESS for impregnating porous castings with metallic oxides has been developed by Tincher Products Co., Sycamore, Illinois, U.S.A., it is reported in *Modern Metals*, February 1952. Various metallic oxides and other mineral particles, sized as small as one millionth of an inch, penetrate the porous area and create a permanent seal. A silicate, or a combination of silicates, of soda provides the vehicle.

The castings are first thoroughly cleaned and degreased. Small castings are placed in an autoclave, and internal circulation is used for large castings. The sealing compound, heated to 180 deg F, is circulated over the castings long enough to bring them up to the same temperature. This expands the porosity to aid the escape of entrapped gases and to facilitate entry of the metallic oxides.

Subsequently, a pressure of 400 lb in² is applied for from five minutes to half an hour, and when pressure is released the castings are washed in plain cold water. Following this, the castings are air-dried and allowed to stand long enough for the oxides trapped in the porosity to oxidize still further and expand.

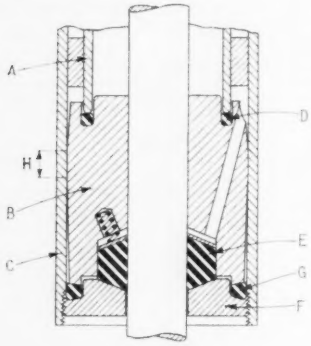
Castings impregnated by this process can be subjected to any pickling or acid bath. The compound does not affect machinability, and the process may be used for castings with baked-on enamel, nickel plate or chromium plate. It is being used for impregnation of aluminium, magnesium, and zinc diecastings as well as for sand-cast iron, steel, stainless steel, bronze, brass, aluminium and magnesium. (2029)

CURRENT PATENTS

A Comprehensive Review of Recent Automobile Specifications

Preventing leaks in shock absorbers

IN hydraulic shock absorbers of the telescopic type a slight deformation of the piston rod, or lack of alignment between the piston and the piston rod, may cause leakage. To seal the inner cylinder A, notwithstanding such adverse conditions, the piston rod guide B is arranged so that it is capable of slight displacement relative to the outer cylinder C to allow self-alignment of the piston rod to take place. By a slight tapering of the external surface of guide B towards each end, a small clearance obtains between it and the outer cylinder for the greater part of its length.



No. 670128

The lower end of guide B is annularly grooved to accommodate a ring D which is engaged by the end of inner cylinder A, thus sealing it to the guide. Three spaced springs set in blind bores in the guide bear against a dished washer to apply pressure to a rubber packing E which is seated on plug F screwed into the upper end of the outer cylinder. This plug also compresses the sealing ring G against the end of the guide.

The guide engages the outer cylinder over approximately only 12 per cent of its length, as indicated at H. With this arrangement the shock absorber will function even if the piston rod is slightly bent. As the guide aligns itself in the outer cylinder, rings D and G will be deformed but still retain their sealing properties. *Patent No. 670128. Armstrong's Patents Co. Ltd. and W. Armstrong.*

Aluminium solder

SOLDERS of the tin-zinc class, containing a preponderating proportion of tin and modified by minor constituents such as aluminium, bismuth, lead, phosphorus and silver, have been known and used for years to solder aluminium and aluminium-base alloys. A major requirement in a solder is good fluidity to give uniform spreading and a complete coverage of the surface to be bonded. The addition of a small percentage of cerium has been found to enhance fluidity and also to improve the corrosion resistance of the solder.

The claims are for solders containing 69·9-98·9 per cent tin, 1·0-30·0 per cent zinc and 0·1-5·0 per cent cerium and also for such compositions with the addition of 0·1-5·0 per cent aluminium. A table of test results on a variety of compositions is included in the specification and shows consistent improvement of fluidity and corrosion resistance as cerium is introduced. *Patent No. 671079. R. Chadwick, W. G. Heaton and Imperial Chemical Industries Ltd.*

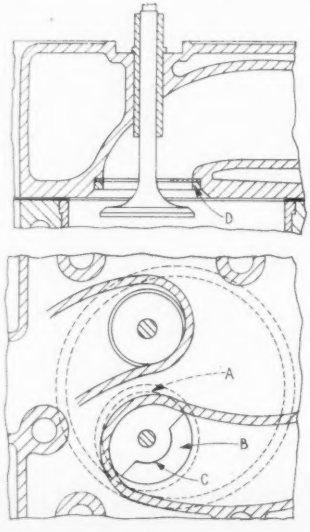
Promoting induction swirl

TO promote a swirl of the air in the combustion chamber of a compression ignition engine, a segmental member is held by an inserted valve seat in such a manner as to project into the air inlet passage and obstruct one side of it. It is claimed that this avoids defects inherent in a masked inlet valve, such as the loss of a beneficial angular displacement of the valve while working, the formation of deposits on the valve and its seating, earlier or incipient leakage, and undesirable shape of valve head. The proposed member changes the cross-section of the air passage in the vicinity of the inlet valve to an asymmetrical form.

In the drawing shown the member has an outer securing rim A and an inwardly projecting segment B which may extend through an angle of approximately 170 deg. At C the inner edge is shaped to a radius struck from the valve stem axis.

The rim portion of the member has the same internal and external diameters as the valve seat D which is pressed or screwed into position in a recess formed in the cylinder head. Alternatively, the valve seat may be rabbeted on its under face to provide space for a segmental member or the projection could be formed integrally with the valve seat.

To determine the optimum position for the member it may be adjusted angularly about the axis of the valve and secured after adjustment. Once established, the correct location can be ensured by means of a dowel. It is suggested that in multi-cylinder engines the optimum position for the member will be different for each cylinder. *Patent No. 670181. W. W. Hamill, A. W. Bird and Henry Meadows Ltd.*



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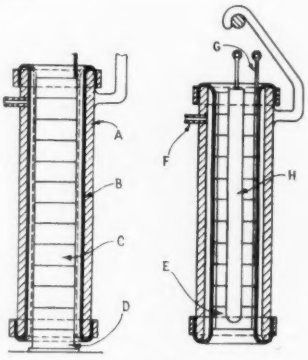

No. 671073

Plating bearing shells

IN the manufacture of cylindrical or half-cylindrical liners having a soft metal bearing surface produced by electro-deposition, it is desirable that the coating is confined solely to the inner surface and the outer surface be completely masked. The carrier comprises a rigid cylinder A, of steel, ebonite or Perspex, with an inner wall constituted by a flexible member B. This tube, of rubber or similar material, is sealed over the ends of cylinder A and secured by clamping rings.

Liners or pairs of half-liners C are positioned on a temporary support D and it is desirable to use dummy end liners E to avoid end effects in plating. The composite cylinder is then inflated by air, water or other fluid under pressure, by way of pipe F, and member B is pressed into intimate contact with the outer surface of the liners.

In a modification, the flexible member B has normally an internal diameter less than the bearing liners and retains them under its own resilience. To enlarge the diameter to facilitate insertion or removal of liners, the pipe F is connected to a source of sub-atmospheric pressure.

Electrical connection is established by a welded connector to one or both of the dummy liners or by a flat, flexible connector G secured between liners and member B. A suitable anode H is suspended centrally. *Patent No. 671073. Glacier Metal Co. Ltd. and P. P. Love.*

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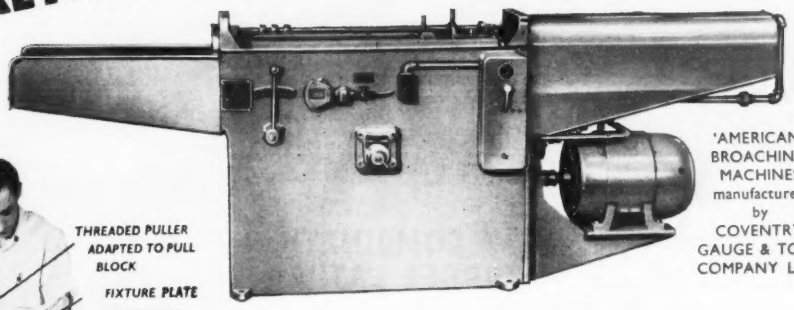

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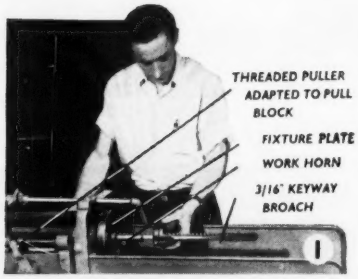

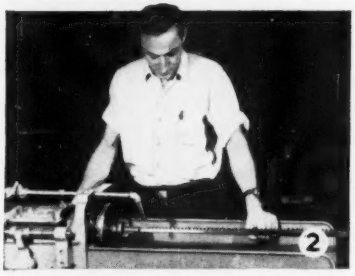

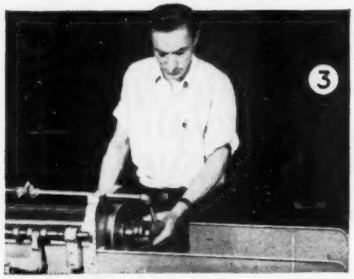

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1. BROACH RETURNING TO STARTING POSITION

Operator holds part over rear end of broach, clear of work horn, and returns broach to starting position.

2. LOADING PART ON WORK HORN

Part is now slipped on to work horn and broaching stroke started.

3. END OF STROKE — UNLOADING

Operator unloads part at end of the 30" stroke and holds new part at end of broach to repeat process.

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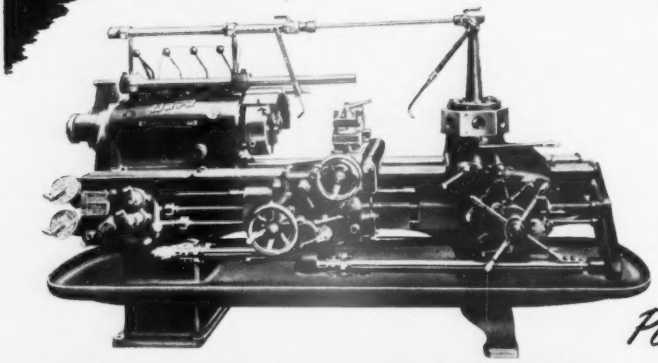

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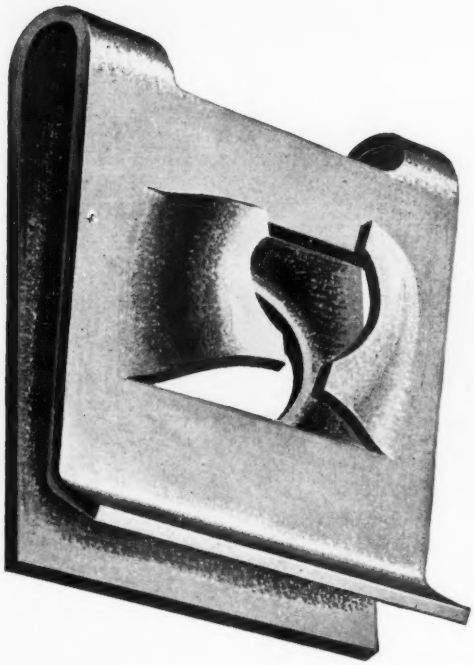

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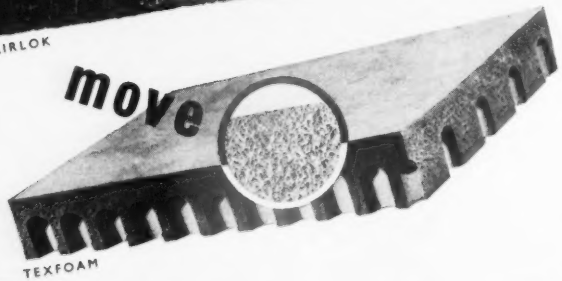

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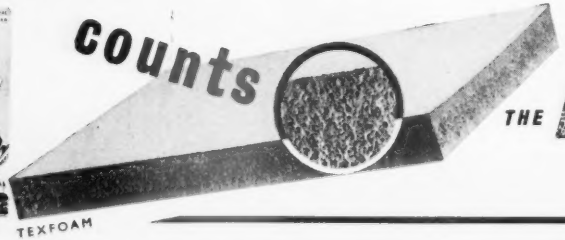

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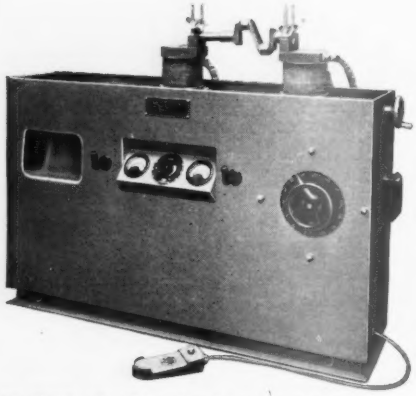

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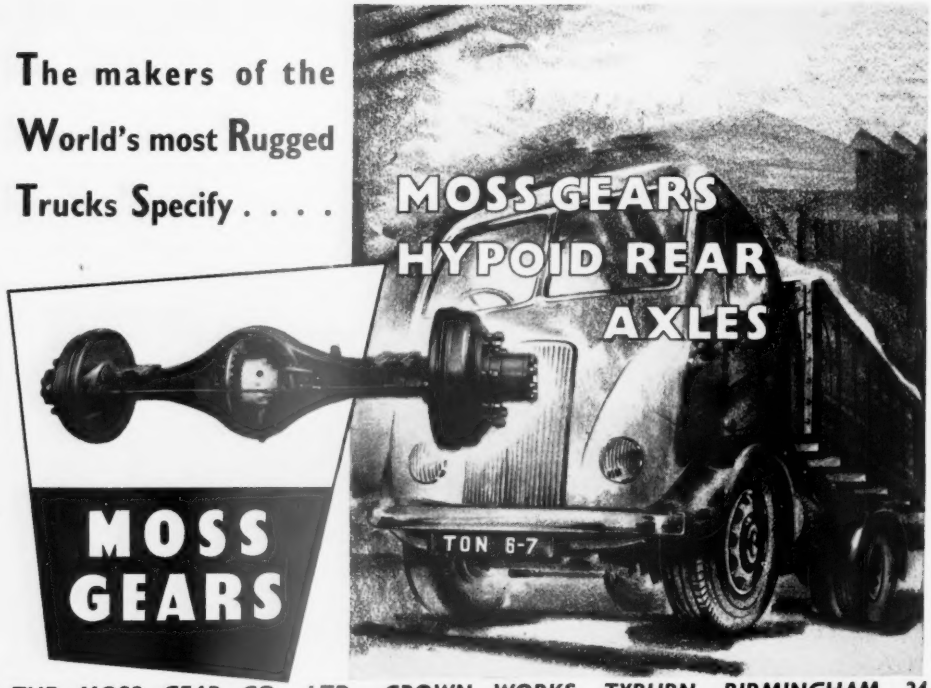

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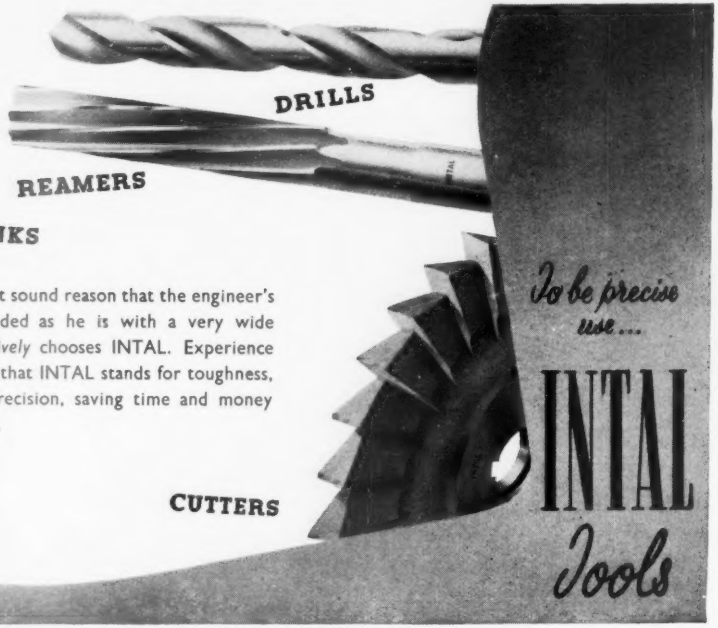

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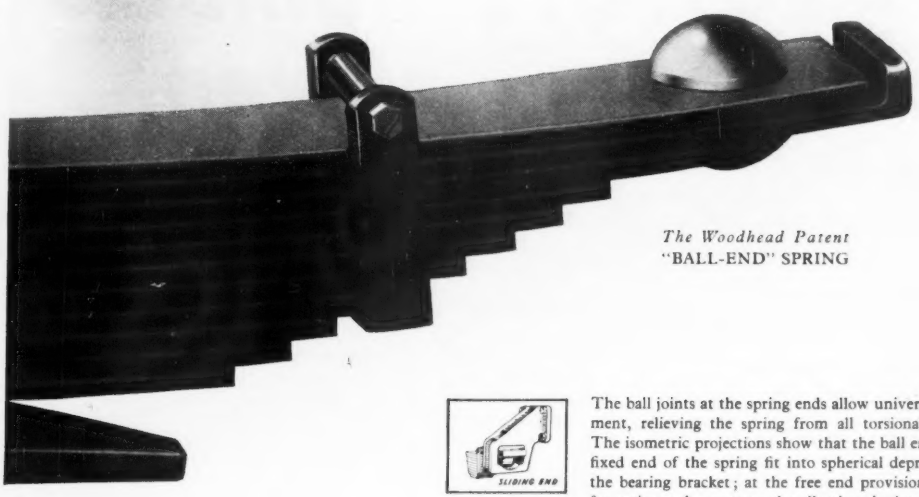

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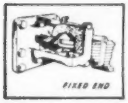

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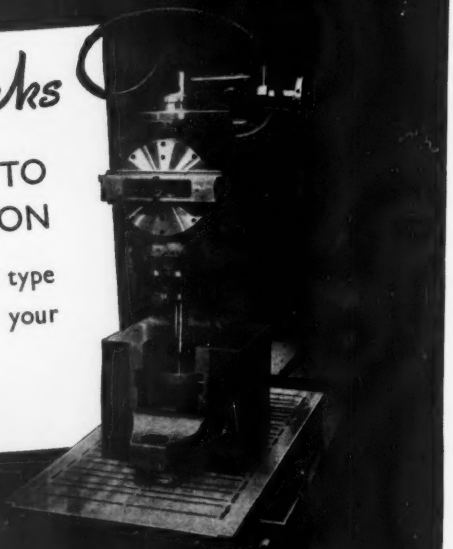

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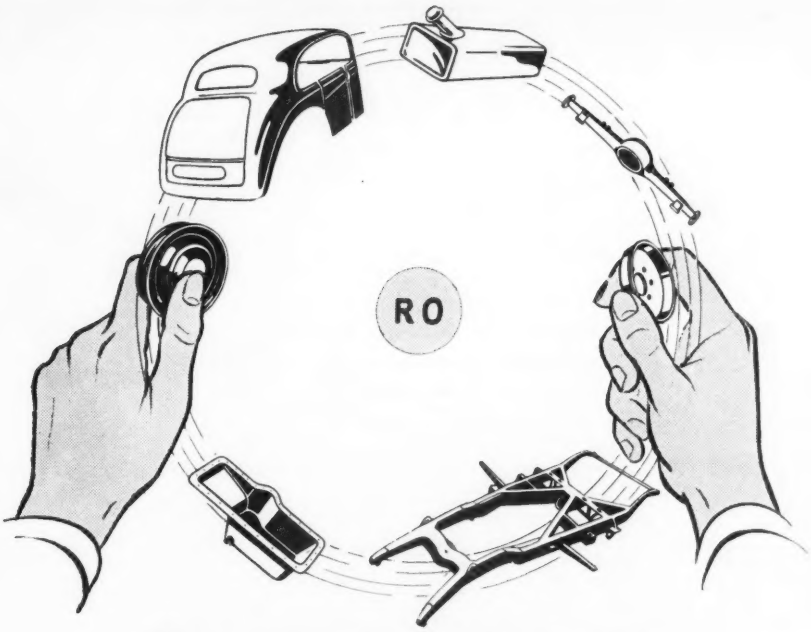

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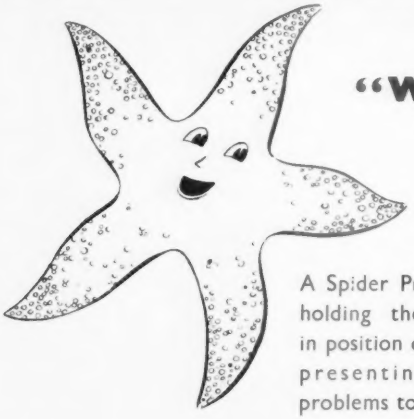

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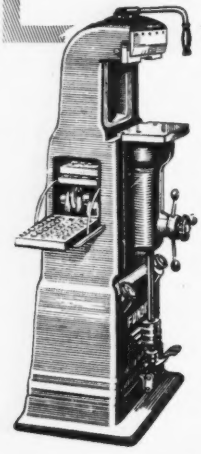

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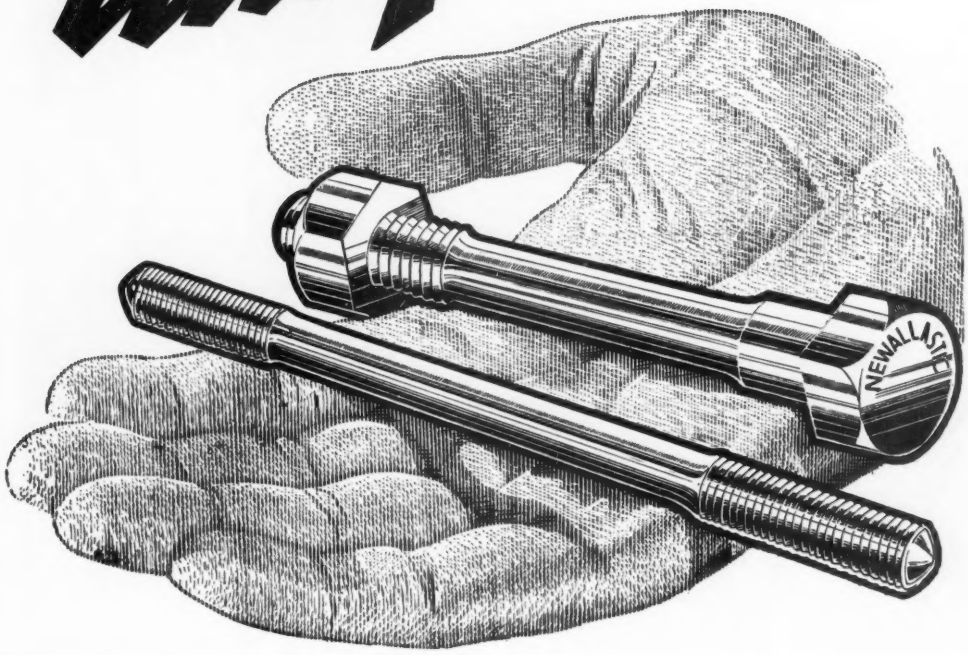

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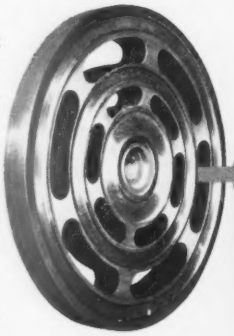

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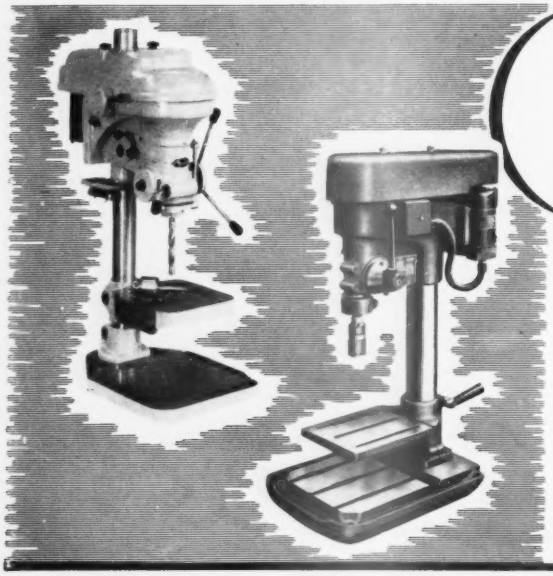

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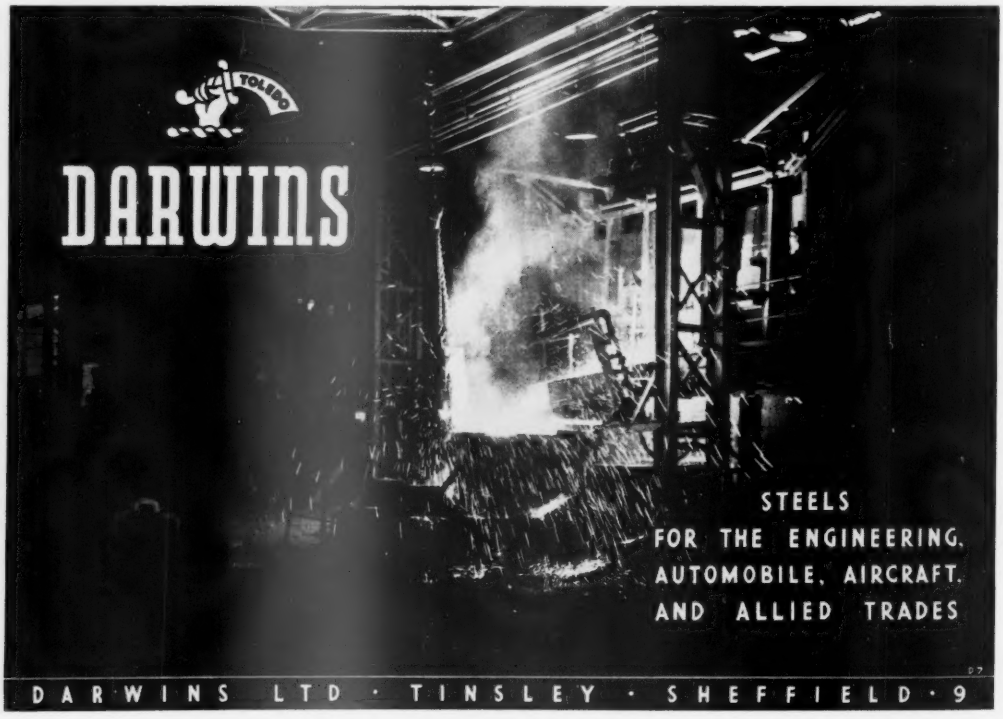

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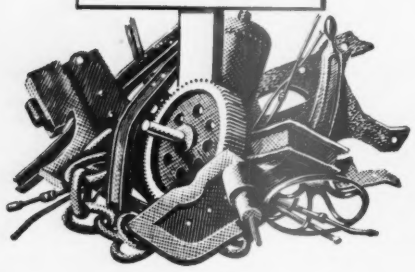
WHAT EVERY MANAGEMENT SHOULD KNOW ABOUT

scrap



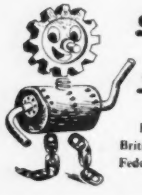
What is scrap?
Obsolete plant and machines, old spares, redundant buildings—anything made from iron and steel for which you have no foreseeable use.

What good is it to me?
No good at all in its present state. But send it back to the steelworks and it can go to make the new steel that you and all steel-users need. Remember—a ton of scrap may make a ton of new steel.

Can't they make steel without scrap?
Yes—but not enough steel. Last year, 58% of our steel was made from scrap. The more scrap we use the more coal, coke and iron ore we save for other important purposes.

What should I do with my scrap?
See your local scrap merchant. He will be glad to help with dismantling and collection. If you have any trouble disposing of iron and steel scrap, write to the British Iron & Steel Federation for the address of your Joint District Scrap Committee.

What shall I get for it?
You will be paid a fair price for your scrap. MORE IMPORTANT—you will be doing yourself and all steel-using firms a great service by helping to increase steel production.



SPEED THE SCRAP

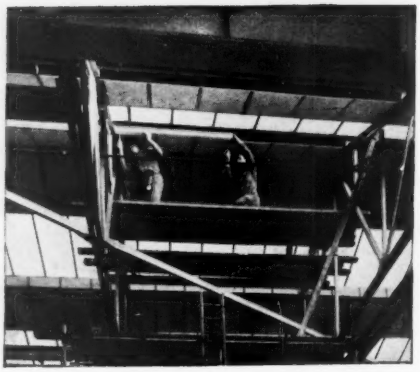
SPEED THE STEEL

Issued for the STEEL SCRAP DRIVE, by the British Iron and Steel Federation and the National Federation of Scrap Iron, Steel and Metal Merchants.

F.28

£1,000,000

Government grant will provide you with capital for factory improvement



25% more fuel for you is available in terms of actual heat merely by reducing the heat wastage in your factory. And it is because of this obvious saving in fuel *to the country* that the Government has announced its intention to assist works managements financially in this war against waste heat.

But financial aid is not enough; what you want is technical advice. Someone who can look over your works and speak with authority on the whole question of thermal insulation as it affects you. Such a man is the Heywood technical representative—there's one in your area. So before you consult your Regional Office of the Ministry of Fuel and Power about that grant—get a figure on it from Heywoods.

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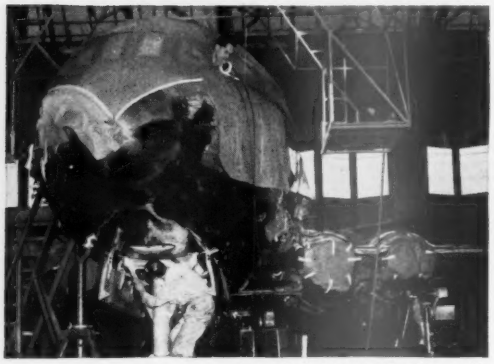
made by Johnson & Johnson



Permacel Cloth Masking Tape being used in protecting a Comet fuselage during painting.

THERE IS A MULTITUDE OF USES for masking tape in the production of aircraft such as the Comet, from taping protective paper on to the giant fuselage to blanking off pipes and ducts in engines on test. For all these jobs, large and small, Permacel Cloth and Creped Paper Tapes are ideal. They will adhere instantly and firmly to the smoothest surface. But apart from this, they have two special advantages which lead to greater efficiency in production. First, they are resilient ; and can be used effectively on sharp corners and irregular surfaces; and secondly, they strip cleanly and easily from all non-fibrous surfaces. The Paper Tapes are, of course, impervious to oils, acids and chemicals.

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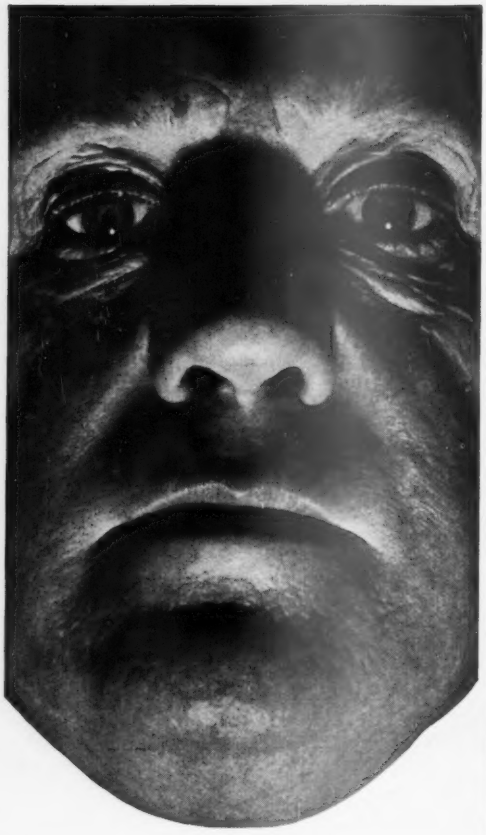

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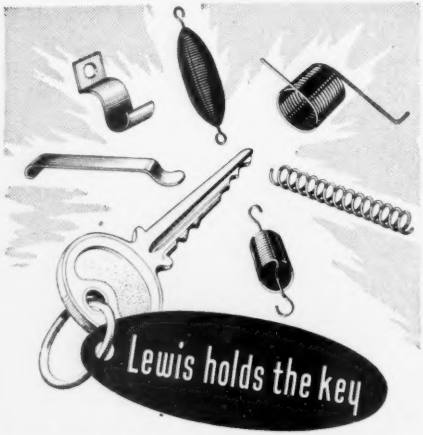

It isn't a magic key or anything like that. It just so happens that we have been called in on many tricky questions over the last thirty years that we now know the answer to most of them. Wouldn't it be a good idea to see us about your new project?
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GP2	$\frac{47}{64}$— $\frac{55}{64}$	$2\frac{1}{4}$	$1\frac{1}{2}$	$2\frac{1}{4}$	$4\frac{7}{16}$
HP2	$\frac{55}{64}$— $\frac{7}{8}$	$2\frac{1}{2}$	$1\frac{1}{2}$	$2\frac{1}{2}$	$4\frac{3}{4}$
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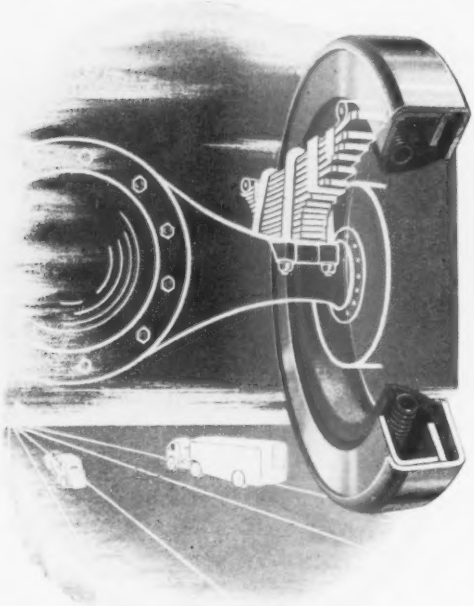

Whatever the machine, if it has shafts that turn, its performance will depend on the efficiency of oil seals. The maximum protection possible must be provided for bearings and WESTON OIL SEALS provide this protection. If you have any sealing problems, our technical staff will welcome a chance to solve them.

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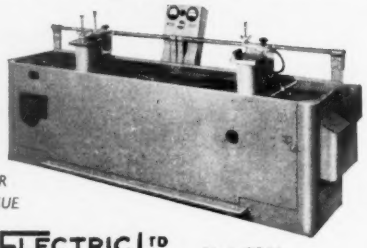

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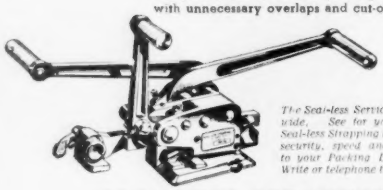

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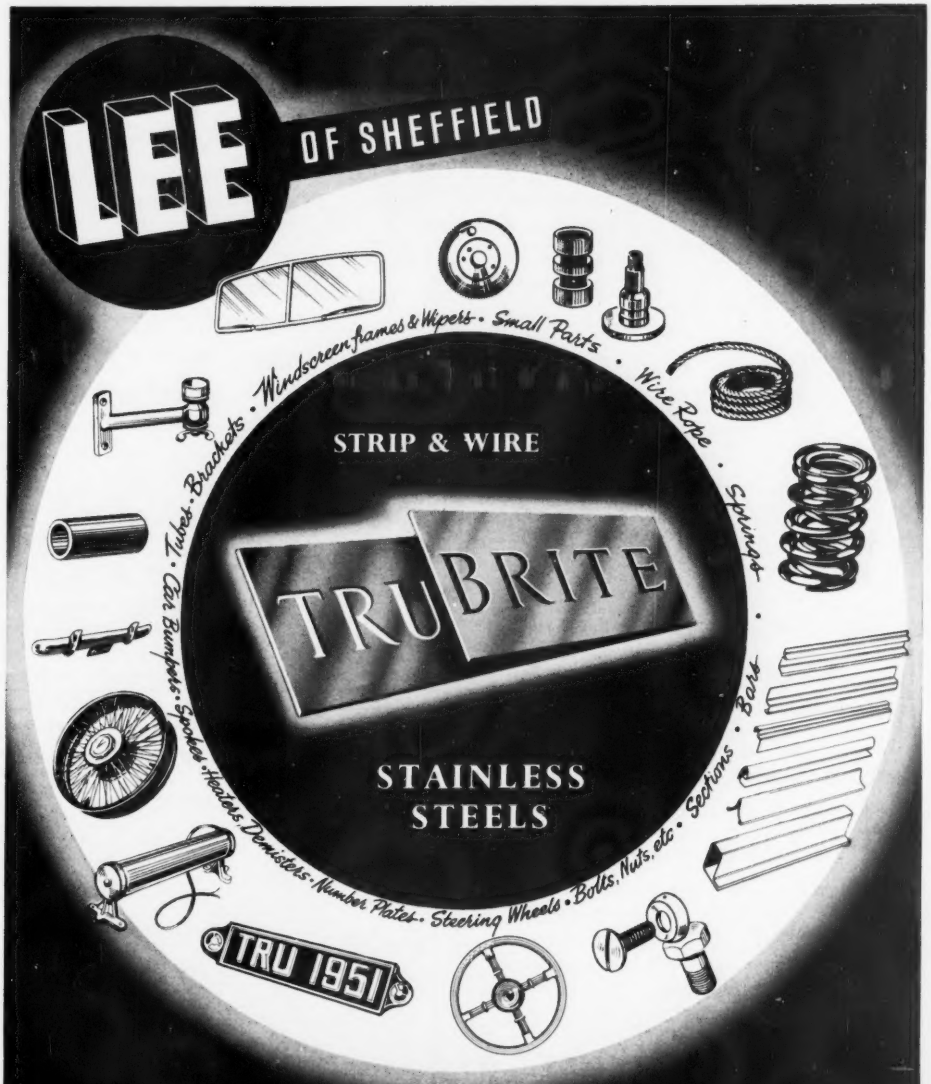
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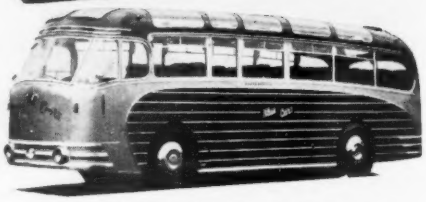

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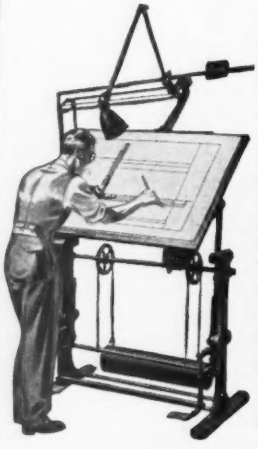

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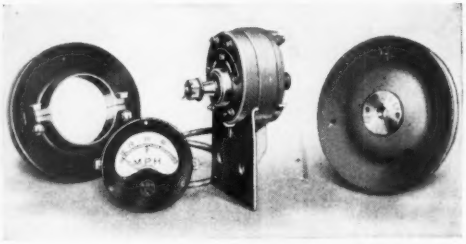

BTH speed-indicating equipment, comprising (left to right) split pulley for transmission shaft; speed-indicator (voltmeter scaled in m.p.h.); generator with bracket and armoured cable; generator pulley. Generator can be supplied for direct drive if desired.

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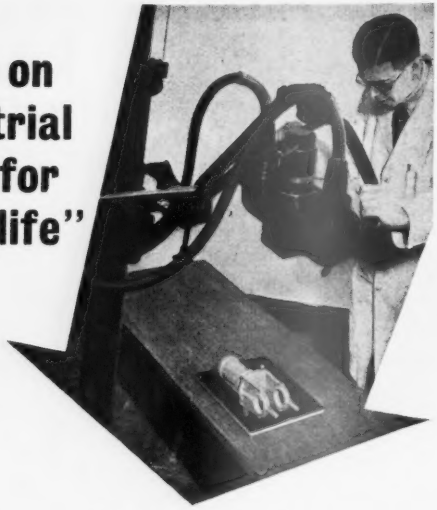

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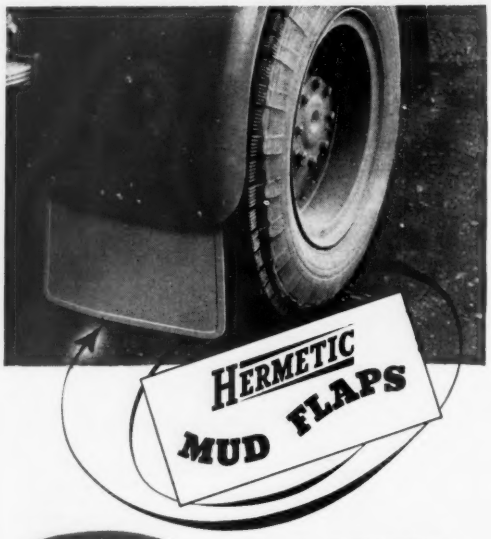

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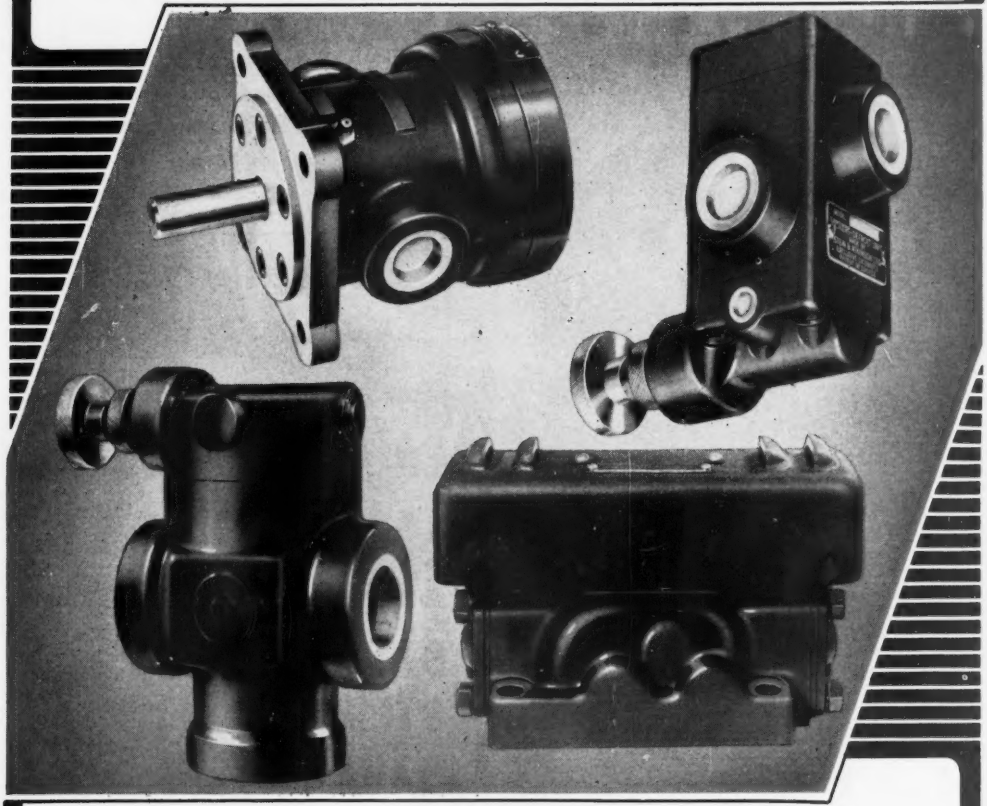

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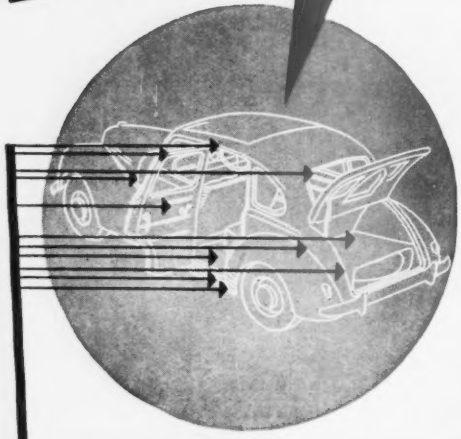

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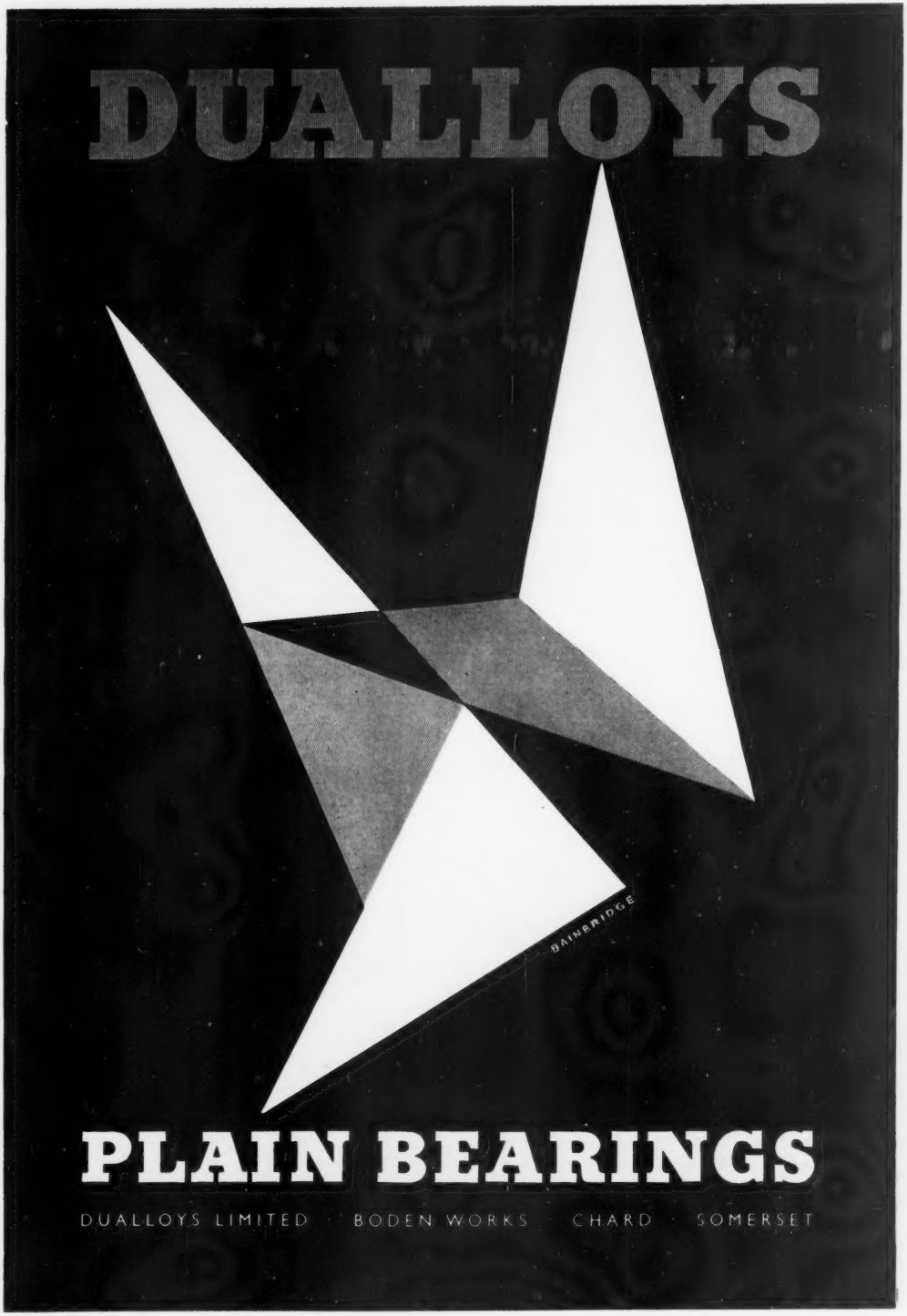
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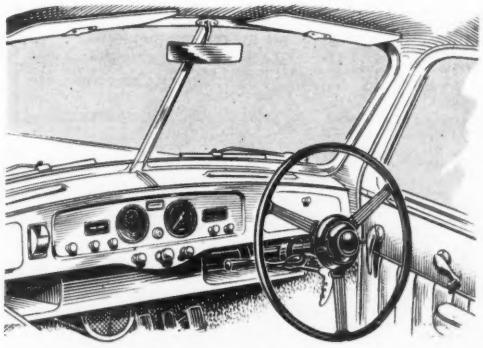

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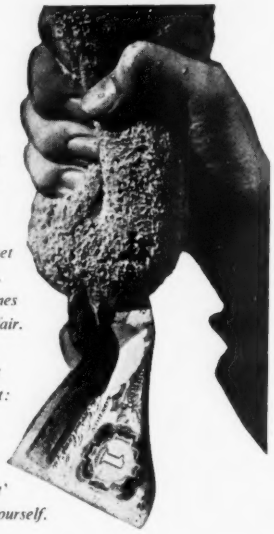

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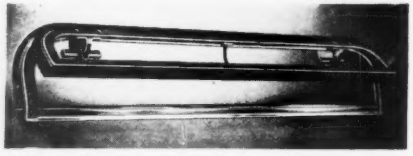

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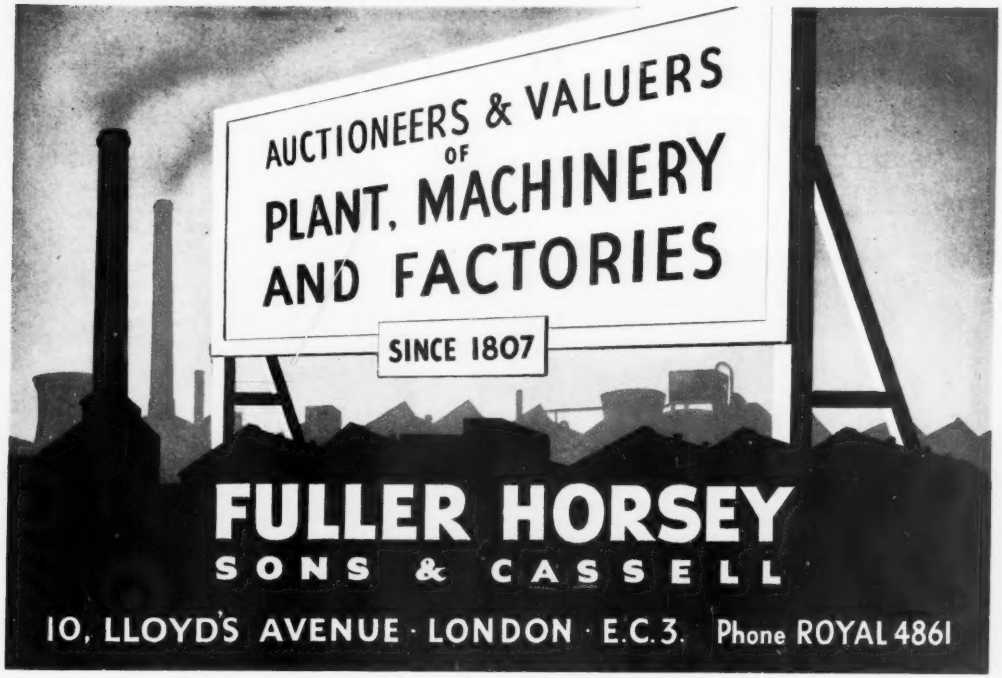

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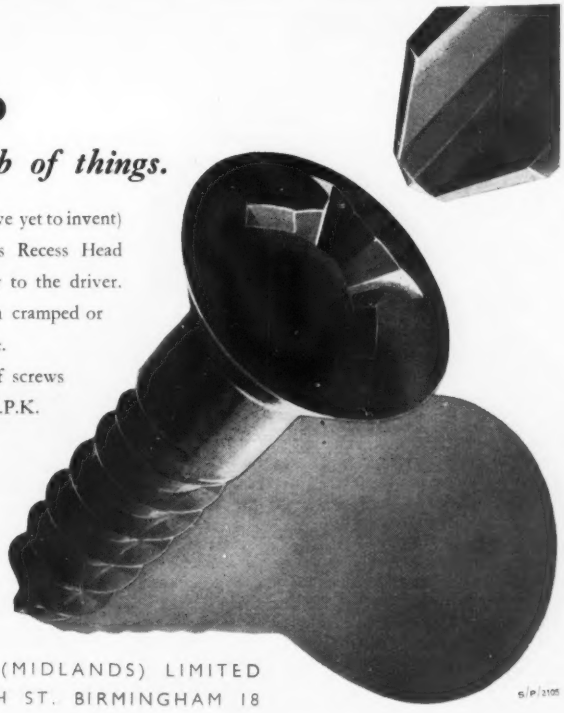

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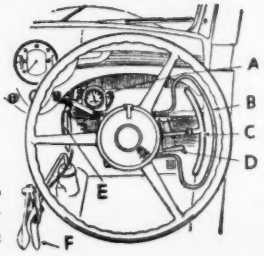

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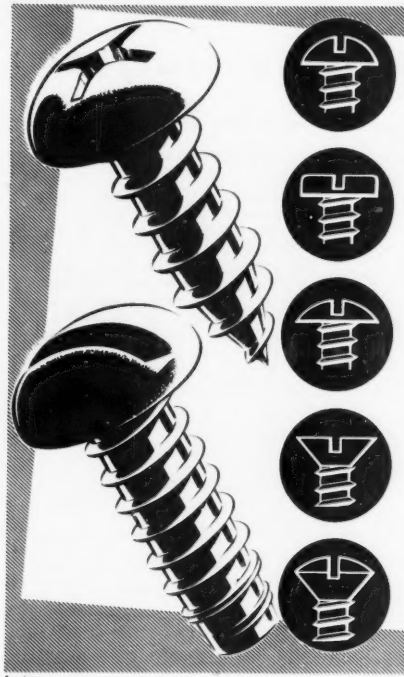

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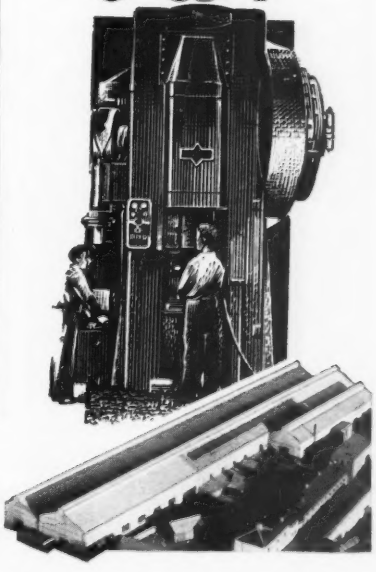

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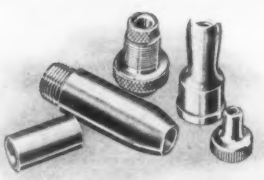

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INDEX TO MANUFACTURERS' ANNOUNCEMENTS

	PAGE
Abingdon King Dick, Ltd.	98
AC Sphinx Spark Plug Co.	17
Adamant Engineering Co., Ltd.	23
Adams Bros. & Burnley, Ltd.	104
Aerialite, Ltd.	132
Aerograph Co., Ltd., The	81
Aluminium Bronze Co., Ltd.	110
Aluminium Die Casting (Birmingham), Ltd.	132
Amal, Ltd.	128
Andrews, Harold, Grinding Co., Ltd.	109
Angus, George & Co., Ltd.	24
Archdale, James & Co., Ltd.	62
Automotive Products Co., Ltd	5, 6, 7, 8
B.B. Chemical Co., Ltd.	130
Birkett, T. M., & Sons, Ltd.	77
Birlec, Ltd.	84
Birmingham Aluminium Casting (1903) Co., Ltd.	Cover iv
Black & Decker, Ltd.	19
Bound Brook Bearings (G.B.), Ltd.	14
Box Number 2125	136
Bramber Engineering Co., Ltd., The	65
British Belting & Asbestos, Ltd.	Cover ii
British Iron & Steel Federation	112
British Oxygen Co., Ltd., The	106
British Thomson-Houston Co., Ltd.	122
British Timken, Ltd.	16, 17
British Wire Products, Ltd.	57
Bryce Berger, Ltd.	82
B.S.A. Tools, Ltd.	40
Burton, Griffiths & Co., Ltd.	40
Bury Felt Manufacturing Co.	49
Bushing Co., Ltd., The	72
Cape Asbestos Co., Ltd., The	54, 55
Carr Fastener Co., Ltd.	128
C.A.V., Ltd.	88
Cashmore, John, Ltd.	124
Churchill, Charles, & Co., Ltd.	18
Clancy, G. Ltd.	94
Clayton Dewandre Co., Ltd.	14
Clayton-Wright, Howard, Ltd.	120
Cleveland Petroleum Co., Ltd.	61
Climax Molybdenum Co. of Europe, Ltd.	99
Cohen, Geo., Sons & Co., Ltd.	96
Cole, E. K., Ltd.	120
Consolidated Pneumatic Tool Co., Ltd.	31
Cooper & Co. (Birmingham), Ltd.	114
Coopers Mechanical Joints, Ltd.	21
Copper & Asbestos Washer Co., Ltd.	139
Cork Manufacturing Co., Ltd.	15
Corrugated Packing & Sheet Metal Co., Ltd.	58
Dale, John, Ltd.	125
Dartmouth Auto-Castings, Ltd.	86
Darwins, Ltd.	108
Delapena & Sons, Ltd.	38
Desoutter Bros., Ltd.	41
Doncaster, Daniel, & Sons, Ltd.	127
Duralloys, Ltd.	131
Dunlop Special Products, Ltd.	32
Eagle Pencil Co., Ltd., The	20
English Steel Corporation, Ltd.	117
Feeny & Johnson, Ltd.	136
Fel Electric, Ltd.	118
Feltham, Walter H., & Son, Ltd.	140
Fenner, J. H., & Co., Ltd.	114
Ferodo, Ltd.	63
Fibreglass, Ltd.	50
Firth, Thos., & John Brown, Ltd.	11
Fischer Bearing Co., Ltd.	28
Fletcher Miller, Ltd.	138
Forgings & Presswork, Ltd.	133
Fuller Gear Boxes	91
Fuller, Horsey, Sons & Cassell	135
Funditor, Ltd.	104
Gas Council, The	2
General Electric Co., Ltd., The	4, 73, 132
Girdex Engineering & Co., Ltd.	136
Girling, Ltd.	60
Graham, H. G., & Son, Ltd.	126
Guest, Keen & Nettlefolds (Midlands), Ltd.	135
Hairlok, Co., Ltd., The	96
Hardy Spicer & Co., Ltd.	111
Harper, John & Co., Ltd.	79
Harris, John, Tools, Ltd.	33
Hassett & Harper, Ltd.	130
Heenan & Froude, Ltd.	43
Herbert, Alfred, Ltd.	83
Hermetic Rubber Co., Ltd.	128
Hey Engineering Co., Ltd.	139
Heywood, W. H. & Co., Ltd.	112
Hoffmann Manufacturing Co., Ltd., The	Cover i
Holroyd, John, & Co., Ltd.	68
Hoyt Metal Co. of Great Britain, Ltd., The	102
Humphreys, J. H. & Sons	102
Ilford, Ltd.	124
Imperial Smelting Corporation, Ltd.	Cover iii
Insley (London), Ltd.	140
International Twist Drill Co., Ltd., The	100
Iso-Speedic Co., Ltd., The	48
Jackson, H., Ltd.	45
Jessop, William & Sons, Ltd.	30
Johnson & Johnson (Gt. Britain), Ltd.	114
Kayser, Ellison & Co., Ltd.	56
Kirkstall Forge Eng., Ltd.	10, 130
Laystall Engineering Co.	113
L.C.C. Paddington Technical College	134
Lee, Arthur & Sons, Ltd.	119
Lewis Spring Co., Ltd.	116
Linread, Ltd.	137
Lloyds (Burton), Ltd.	107
Marbaix, Gaston, E., Ltd.	76
Marshall, C. & C., Ltd.	136
Mavitta Drafting Machines, Ltd.	120
M.C.L. and Repetition, Ltd.	140
Mek-Elek Engineering, Ltd.	140
Metalastik, Ltd.	70, 71
Metropolitan-Vickers Electrical Co., Ltd.	98
Midland Mechanical Developments, Ltd.	121
Midland Motor Cylinder Co., Ltd., The	27
Mills, Exors. of James, Ltd.	12
Mond Nickel Co., Ltd., The	51
Monks & Crane, Ltd.	3
Morgan Crucible Co., Ltd., The	87
Moss Gear Co., Ltd.	100
Murad Developments, Ltd.	52
Newall, A. P. & Co., Ltd.	105
Newton & Bennett, Ltd.	13
Nitralloy, Ltd.	137
Northern Automatic Screw Co., Ltd.	138
Osborn, Samuel, & Co., Ltd.	141
Philidas Division of Whitehouse Industries, Ltd.	29
Plastomatic, Ltd.	133
Ransome & Marles Bearing Co., Ltd.	33
Redifon, Ltd.	90
Renfrew Foundries, Ltd.	85
Richards, Charles & Sons, Ltd.	126
Rockwell Machine Tool Co., Ltd.	93
Rubber Bonders, Ltd.	80
Rubery, Owen & Co., Ltd.	103
Salter, George & Co., Ltd.	22
Seal-Less Strapping, Ltd.	118
Sheffield Twist Drill & Steel Co., Ltd., The	59
Shell-Mex & B.P., Ltd.	9
Silentbloc, Ltd.	39
Simmonds Aerocessories, Ltd.	95
Skefko Ball Bearing Co., Ltd., The	92
Slick Brands, Ltd.	110
Smith, W. H., & Son	122
Smith-Clayton Forge	123
Small & Parkes, Ltd.	97
Solus-Schall, Ltd.	116
South Wales Forgemasters, Ltd.	137
Steel Company of Wales, Ltd., The	115
Stein & Atkinson, Ltd.	129
Super Oil Seals & Gaskets, Ltd.	67
Sutcliffe, Speakman, & Co., Ltd.	134
Taylor & Jones, Ltd.	116
Tecalemit, Ltd.	42
Tenaplas (Sales), Ltd.	124
Terry, Herbert, & Sons, Ltd.	44
Thomas, Richard, & Baldwins, Ltd.	47
Thompson, John, Motor Pressings, Ltd.	141
Toledo Woodhead Springs, Ltd.	53
Tricо-Folberth, Ltd.	126
Udal, J. P.	108
United Steel Companies, Ltd.	46
Van Moppes & Sons (Diamond Tools), Ltd.	64
Vokes, Ltd.	26
Walker, M. W., & Staff, Ltd.	66
Ward, H. W. & Co., Ltd.	94
Ward, Thos. W., Ltd.	106
Watveare Overseas, Ltd.	105
Weathershields, Ltd.	134
Wellworthy Piston Rings, Ltd.	122
Weston, Charles, & Co., Ltd.	118
West Yorkshire Foundries, Ltd.	89
Wickman, A. C., Ltd.	1, 25, 74, 75
Wiggin, Henry, & Co., Ltd.	69
Wild-Barfield Electric Furnaces, Ltd.	78
Wilmot-Breeden, Ltd.	36
Woodhead, Jonas, & Sons, Ltd.	101
Yarwood, Ingram & Co., Ltd.	142
Zinc Alloy Diecasters' Association	134

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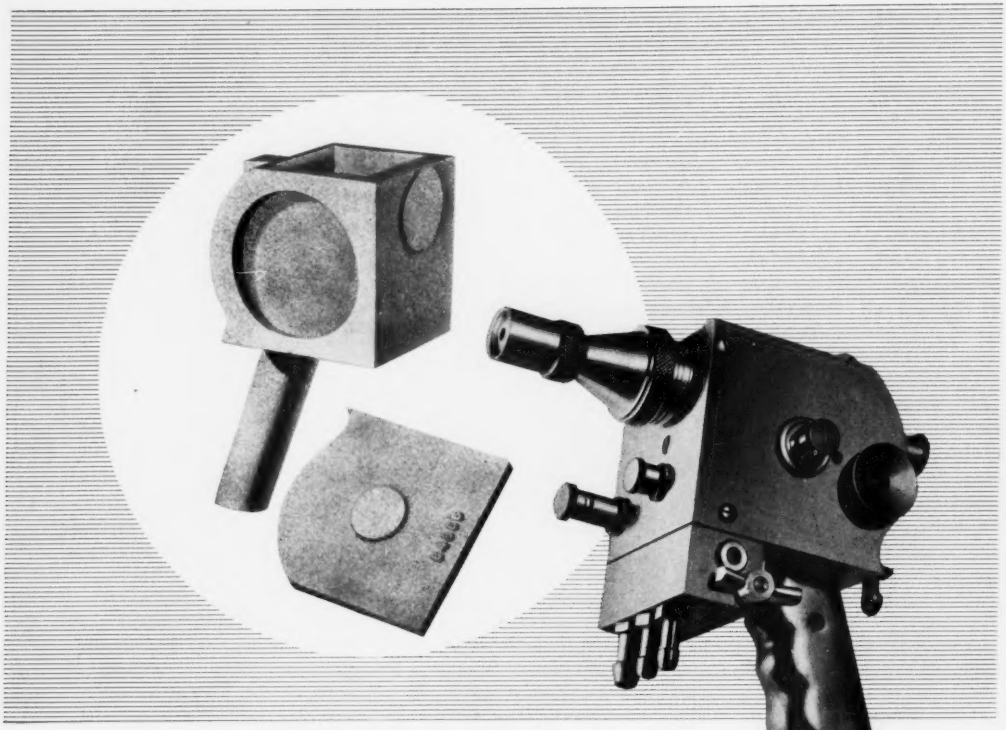

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